PROCEEDINGS

OF THE

ROYAL SOCIETY OF EDINBURGH.

VOL. IX. 1877–78. No. 100.

NINETY-FIFTH SESSION.

Monday, 26th November 1877.

SIR WILLIAM THOMSON, President, in the Chair.

The following Council were elected:—

President.
SIR WILLIAM THOMSON, KNT., LL.D.

Honorary Vice-Presidents, having passed the Chair.
HIS GRACE THE DUKE OF ARGYLL.
SIR ROBERT CHRISTISON, BART., M.D.

Vice-Presidents.

Rev. W. LINDSAY ALEXANDER, D.D.
DAVID STEVENSON, Memb. In. C.E.
The Right Rev. Bishop COTTERILL.
Principal Sir ALEX. GRANT, Bart.
DAVID MILNE HOME, LL.D.
Sir C. WYVILLE THOMSON, LL.D.

General Secretary—Dr JOHN HUTTON BALFOUR.

Secretaries to Ordinary Meetings.
Professor TAIT.
Professor TURNER.

Treasurer—DAVID SMITH, W.S.

Curator of Library and Museum—Dr MACLAGAN.

Councillors.

Dr RAMSAY H. TRAQUAIR.
THOMAS HARVEY, LL.D.
Professor JOHN G. M'KENDRICK.
Professor CRUM BROWN.
Professor KELLAND.
Professor FLEEMING JENKIN.
Rev. R. BOOG WATSON.
Dr HUGH CLEGHORN.
Professor T. R. FRASER.
Professor RUTHERFORD.
Dr R. M. FERGUSON.
Sheriff HALLARD.

Monday, 3d December 1877.

Principal Sir Alexander Grant, Bart., one of the Vice-Presidents of the Society, read the following Opening Address:—

Gentlemen,—I find it recorded* that in the year 1662, which was the first year of the incorporation of the Royal Society of London, the celebrated mathematician, Robert Hooke, drew up "Proposals for the good of the Royal Society," the third article of which was as follows:—"That every member of the Society shall be equally obliged to promote the ends thereof by paying 52s. yearly, and by doing some one duty that shall be charged on him by the Council once a year, or, if his occasions will not permit, to pay 52s. more per annum." This proposed salutary rule does not seem ever to have been enacted by the Royal Society of London, nor do I believe that any analogous article forms part of the statutes of this Society, and yet it is in accordance with the spirit of such a rule that I appear before you this evening.

When the Council of this Society requested me, only four weeks ago, to open the ensuing session by addressing you, I at once, though perhaps imprudently, resolved to obey them, and to do "the one duty charged upon me by the Council." But in the meantime I have become more and more conscious of the fact, that probably no length of preparation would have enabled me to offer you an address worthy of this occasion and of my predecessors in this chair, and that it would be a simple impossibility to accomplish this within a few weeks at a period of the year when the distractions are so manifold that I can scarcely get a clear morning, not to speak of a clear day. I must therefore ask you to accept for the nonce some discourse on matters which are a very old story now. I know that the Royal Society is like those Athenians of whom it was said that they "spent their time in nothing else, but either to tell or to hear some new thing." Therefore, an idea to be suitable for the Royal Society ought to be brand new. But I shelter myself under the reflection, that the topic which has suggested itself to my mind for this evening is one which might perhaps always claim a certain welcome in this room. For I thought of whiling away the opening half-hour of our new session with some remarks upon our connection with him whom I cannot but regard as our lineal progenitor and virtual founder, Francis Bacon of Verulam. In the Harveian Society, I believe that there is an annual eulogy of the great discoverer of the circulation of the blood; and how often in medical societies has the opening address been given up to a panegyric of Hippocrates, the ancient father of medicine? In societies like this, whose main function is the promotion of experimental research, it can never be out of place to do honour to Lord Bacon, the august herald and prophet of modern science. I trust that you will concede me this proposition, and that you will excuse the introduction of a trite subject on the present occasion, and that you will bear with me if I repeat many things which are quite familiar to you.

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* In Weld's *History of the Royal Society*, vol. i. p. 139. To this excellent history the following paper is much indebted.

Principal Forbes, in an excellent address which he delivered in this place fifteen years ago, traces the origin of the Royal Society of London to the example of similar societies which sprang up in Italy during the 16th and 17th centuries, especially the Society of *Lincei*, or Lynx-eyed Ones. founded in 1604, of which Galileo was a member, and the Florentine Academy of Experiment ('del cimento'), founded in 1657. This view was, broadly speaking, correct; but I think that it ignores too much the forces working within England itself. During the 15th and 16th centuries there was carried out the most important revolution (except the introduction of Christianity) that ever occurred among the human race—namely, the overthrow of scholasticism, and the introduction into all departments of knowledge of the modern spirit of inquiry. This revolution was far greater and more important in its consequences than the downfall of any dynasty, or the destruction of any empire; greater and more important than the Renaissance and the Reformation which jointly led to it; far greater in its scope and results than the much-vaunted French Revolution, of which, to the present day, it seems so hard for France to reap the fruits. In contributing to this greatest of all changes, in ushering in the new era, Italy may claim to have played a glorious part. But the new spirit pervaded all Europe. Men of the new era seemed to spring up everywhere. Columbus in Spain, Copernicus and Kepler in Germany, Lionardo da Vinci and Galileo in Italy, Tycho Brahe in Denmark, Gassendi and Descartes in France, Harvey and Gilbert in England,—these and many more, as if inspired by some special impulse, had each started on a separate road of discovery. They each shone like separate lights, and their united effulgence created the new day. Countries, I think, as well as individuals, moved independently of one another. At all events, I think that England moved independently of Italy in respect of the formation of scientific societies. In the eighth volume of your "Transactions" there is a learned paper contributed by Professor Macvey Napier fifty-nine years ago, in which he collects from writers of the 17th century, evidences of the influence exercised by Lord Bacon's works, and of the high esteem in which they were held. Professor Napier's case is fully made out, and he not only establishes the general fact that Bacon made a deep impression on his own age and the succeeding times, but also he proves, in particular, the immediate and direct connection between Lord Bacon's writings and the foundation of the Royal Society. The original founders of the Royal Society had those writings continually in their thoughts. Bacon's splendid aspirations, clothed in some of the stateliest prose that the world has ever seen, had struck upon men's minds and filled them with enthusiasm. Bacon was not content with setting forth his views in the abstract, but in his *New Atlantis* he exhibited in concrete, but imaginary, form, the benefits which would result, and the state of things which would arise, when the new philosophy had been thoroughly welcomed, and experimental science had been thoroughly established among men. The chief feature in Bacon's undiscovered island of the fancy was "Solomon's House," in which the employments of the Fellows are described as follows:—"We have twelve that sail into foreign countries, who bring in the books and patterns of experiments of all other parts. These we call Merchants of Light. We have three that collect the experiments which are in all books. These we call Depredators. We have three that collect experiments of all mechanical arts, and also of liberal sciences, and also of practices which are not brought into arts. These we call Mystery-men. We have three that try new experiments, such as themselves think good. These we call Pioneers or Miners. We have three that draw the experiments of the former four into titles and tablets, to give the better light for the drawing of observations and axioms out of them. These we call Compilers. We have three that bind themselves to looking into the experiments of their fellows, and cast about how to draw out of them things of use and practice for man's life and knowledge. These we call Dowry-men, or Benefactors. Then, after divers meetings and consults of our whole number, to consider of the former labours and collections, we have three that take care, out of them, to direct new experiments, of a higher light, more penetrating into nature than the former. These we call Lamps. We have three others that do execute the experiments so directed, and report them. These we call Inoculators. Lastly, we have three that raise the former discoveries by experiments into greater observations, axioms, and aphorisms. These we call Interpreters of Nature."

Rawley, Lord Bacon's chaplain and literary executor, says in his preface to the *New Atlantis*, which was published in 1627, soon after Bacon's death—"This fable my lord devised, to the end that hee might exhibite therein a modell or description of a college, instituted for the interpreting of nature, and the producing of great and marvellous works for the benefit of men, under the name of 'Solomon's House, or the College of the Six Dayes' Works.'"

Bacon's imaginative conception, being so consonant as it was to the spirit of the age, took root and fructified in the minds of many of his countrymen, both those who were passing through the trying scenes of the civil war in England, and those who had accompanied Charles II. into his exile. The first attempt to realize the conception seems to have been made about nineteen years after Bacon's death, in the year 1645, by the formation in London of a scientific society called the "Philosophical College," which was also called the "Invisible College." Dr Wallis, in his autobiography, speaks of this society as consisting of "divers worthy persons, inquisitive into natural philosophy and other parts of human learning, and particularly of what hath been called the New Philosophy, or Experimental Philosophy."

Several eminent Oxford men who were in London in 1645, owing to the interruption of university work caused by the civil wars, became members of the "Invisible College;" and in 1649, returning to their *Alma Mater*, they founded the Philosophical Society of Oxford, which used to meet in the house of Dr Wilkins, then Warden of Wadham College, and afterwards Bishop of Chester, or in the apartments of the Hon. Robert Boyle, who was then residing in Oxford.

Ten years later, in 1659, the accomplished and philanthropic Evelyn addressed to Robert Boyle a letter containing his proposal for the erection of " a Philosophic-Mathematic College," which letter is full of Baconian inspiration. In it he says that, "since we are not to hope for a Solomon's house in this sad *catalysis* (or dissolution of things), and *inter los armorum strepitus*, a period so uncharitable and perverse, why not might some gentlemen, whose geniuses are greatly suitable, and who desire nothing more than to give a good example, preserve science, and cultivate themselves, join together in society, and resolve upon some orders and economy to be mutually observed, such as shall best become the end of their union?" He then offers cheerfully to devote his fortune to the carrying out of this scheme; and he proceeds to say, in the Baconian manner:—" I propose the purchasing of thirty or forty acres of land in some healthy place not above twenty-five miles from London, of which a good part should be tall wood, and the rest upland pastures or downs, sweetly irrigated. We would erect upon the most convenient site of this, near the wood, our building, viz., one handsome pavilion, containing a refectory, library, and withdrawing-room;" this is the first storey. The second storey was to contain "a fair lodging-chamber, a pallet-room (*i.e.* a second-class bedroom), and gallery, all of which should be well and very nobly furnished, for any worthy person that might desire to stay any time, and for the reputation of the college." There were to be six members of the college, each of whom was to have his cell and a private garden, "somewhat after the manner of the Carthusians." Many details followed as to the mode of life to be pursued in this institution, "the principal end" of which was to be the "promotion of experimental knowledge." Of course, this dream of Evelyn's was never carried out; it is only mentioned as showing the sort of ideas which the study of Bacon had engendered in men's minds, and which finally resulted in the establishment of the Royal Society.

A somewhat similar scheme was published about the same time when Evelyn's letter was being written, by the poet Cowley, under the title of a *Proposition for the Advancement of Experimental Philosophy.* This was to be effected by the creation of a Philosophical College, with a revenue of £4000 a year, and a staff of 64 persons, among whom are included 20 philosophers or professors;

16 young scholars, servants to the professors; a chaplain; a chirurgeon; "2 lungs, or chymical servants,"* and 4 old women to tend the chambers. This college was to examine all existing theories of nature, and to separate the true coins from those "false moneys with which the world has been paid and cheated so long." Secondly, it was to recover the lost inventions of the ancients. Thirdly, it was to improve all arts which we now have, and discover others which we yet have not.

These Baconian imaginings never obtained a literal fulfilment. But in the next year, in 1660, immediately after the restoration of Charles II., they received a modified realisation in the establishment of the Royal Society. It is a point of some little interest that the chief agent in effecting this result was a Scotsman. This was the good Sir Robert Moray, who had accompanied the king in exile, and who, at the Restoration, was made a Privy Councillor, and much consulted on affairs of State. He was an ardent naturalist, and on the king's return to London in June 1660, he appears to have joined the meetings of the "Invisible College," at one of which, in November of the same year, the schemes for a Physico-Mathematical College were discussed, and it was resolved by the members present to give themselves a more definite and regular constitution, "according to the manner in other countries, where there were voluntary associations of men in academies for the advancement of various parts of learning, so they might do something answerable here for the promoting of experimental philosophy." Sir Robert Moray was present at this meeting, and in his intercourse with the king he took occasion to communicate the proposal to His Majesty. At their next meeting, a week later, he was able to state to his friends that the king "did well approve of their design, and would be ready to give encouragement to it." The members at once constituted themselves the "Royal Society," and Sir Robert Moray became their first president *ad interim*. About a year and a half later, in July 1662, the Society received its charter of incorporation. Lord Brouncker, who was a discoverer in mathematics,—"being the first to introduce continual fractions, and to give a series for the quadrature of a portion of the equilateral hyperbola,"—was named president in the Royal Charter. The king continued to take an interest in the Society, and was often present at their experiments in his gardens, his parks, or on the Thames; and he even condescended to chide them "on the slowness of their proceedings."

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* The "lung" was so called because he blew the fire for his master.

In 1663 he presented them with their mace. The charter and the mace are the only substantial favours which Charles II. appears to have conferred upon the Royal Society, and for a long period they worked on, by means of the genuine enthusiasm of the fellows, with no funds at their disposal for scientific purposes. I think it is amusing to observe that Sir Robert Moray so far contrived to give a Scottish character to the Society, that their mace was decorated all over with the thistle, and that St Andrew was chosen as their patron saint.

As soon as the Royal Society was established, its members connected it with the name of Bacon. Bishop Sprat, who published a history of the Society in 1667, writes:—"The Royal Society was a work well becoming the largeness of Bacon's wit to devise, and the greatness of Clarendon's prudence to establish." Oldenburg, the first secretary of the Society, says:—"The enrichment of the storehouse of natural philosophy was a work begun by the single care and conduct of the excellent Lord Verulam, and now prosecuted by the joint undertakings of the Royal Society." Glanvil, in his work called *Plus Ultra, or the Advancement of Knowledge since the days of Aristotle,* after alluding to the *New Atlantis,* says:—"This the great man desired, and formed a society of experimenters in a romantic model; but he could do no more—his time was not ripe for such performances. These things, therefore, were considered by later virtuosi, who several of them combined together, and set themselves to work upon his grand design." Professor Napier quotes several other more obscure authorities, to show the same opinion of Lord Bacon entertained in the minds of Englishmen. One Dr Power, in 1664, in a work on the discoveries of Galileo, Torricelli, and Pascal, calls Bacon "the patriarch of experimental philosophy." Another writer, of the same year, with the unfortunate name of Mr Havers, says that "Lord Bacon's way of experiment, as now prosecuted by sundry English gentlemen, affords more probabilities of glorious and profitable fruits than the attempts of any age or nation whatsoever;" and Dr Childrey entitled his work on the *Natural Rarities of England,* "*Britannia Baconica,*" in order to indicate its connection with those studies which Bacon had originated. Lastly, I may perhaps be allowed to quote the well-known lines from the *Ode to the Royal Society*, by Cowley, himself one of the earliest fellows, in which, after detailing the futility of the early philosophy, he says:—

> "From these and all long errors of the way,
> In which our wandering predecessors went,
> And, like th' old Hebrews, many years did stray
> In deserts but of small extent,
> Bacon, like Moses, led us forth at last,
> The barren wilderness he past,
> Did on the very border stand
> Of the blest promised land,
> And from the mountain-top of his exalted wit,
> Saw it himself, and showed us it."

Kuno Fischer says that Bacon was an "epoch-making" thinker, who put men into a new attitude towards things, and opened a new world of possibilities. I think that it would be more strictly true to say that Bacon was an "epoch-marking" man, a herald and fugleman, created and sent forward by his epoch. He was himself unconscious of that; he thought of himself as a solitary worker; he fancied that he derived nothing from others. He mentions his own case as a source of encouragement, and says:—"Some hope might, I think, be afforded by my own example; and I do not say this for the sake of boasting, but because it may be useful. If any feel a want of confidence, let them look at me, who of all my contemporaries have been most engaged in public affairs, who am of somewhat infirm health (which of itself occasions great loss of time), and who in this matter have assuredly been the first explorer, neither following in the steps of another, nor communicating with a single individual, but who, nevertheless, by entering firmly on the right way, and in submitting my mind to *things*, have, methinks, to some extent advanced these matters." It is true that Bacon, in solitary meditation, during the intervals of the law courts and State affairs, built up the fabric of his philosophy, as a poet builds up an epic poem or a drama. In 1605 he published his *Advancement of Learning*, which was meant to be a map of the existing state of human knowledge in all its various provinces, with a note of the facts in which knowledge was deficient, and an exhortation to supply these deficiencies. The whole was to be a prelude to his *Instauratio Magna*, or entire remodelling of the sciences, and was intended especially to catch the mind of James I., who was, however, of too pedantic an intellect, and too much absorbed in theology, to rise to the level of Bacon's great argument. In 1620, when Lord Chancellor of England and Baron Verulam, he brought out his *Novum Organum*, or new method of the sciences, in two divisions, of which the first was destructive of scholasticism, and the second constructive of a better way. The *Novum Organum* contained the chief pith of Bacon's philosophy, but of this only the first or destructive part was complete. No praise can be too high for the manner in which scholasticism is for ever annihilated in this treatise. The trenchant criticism, the large and luminous good sense, the grand and true conceptions of man's relation to nature, the striking metaphors—now as familiar as household words—which pervade the first part of Bacon's *Organum*, have rendered it an immortal work, from the point of view of literature as well as of philosophy. But it would be ludicrous to maintain that, in writing it, Bacon followed the footsteps of no one. There had been a host of attacks upon Aristotle and the Aristotelians. Ramus, in Paris, as a young man, had sustained the thesis, that "everything which Aristotle had said was false." Patrizzi, in Venice, had published an assault upon Aristotle characterised by the utmost malignity. Galileo, at Pisa, had roused the anger of the Aristotelians by demonstrating that Aristotle was in error when he said that heavy bodies fall faster than light ones. The air in Europe was full of revolt against scholasticism, and yet Bacon thought that when he laid down, in his brilliant way, that "Truth is the daughter of Time, and not of authority;" that the "ancients were the children of the world;" and that "the syllogism is unequal to the subtlety of things," he was stating something original, and not following in the footsteps of any one. Bacon, having imbibed, with the quick apprehension of genius, numberless suggestions from his contemporaries and predecessors, at once kicked down the ladders on which his mind had risen; he spoke with the greatest disdain of Ramus and Patrizzi; and he so little appreciated Galileo that, when informed of some of the labours upon which Galileo was engaged, he said to his informant:—"I wish you would persuade those Italian astronomers to give up amusing us with their idle stories, and stick a little closer to the experience of the senses." It is a most curious circumstance that Bacon, with all his great intellect, could not stomach the Copernican theory. Indeed, in some things he was even behind his age. He spoke slightingly of Gilbert as a mere specialist—Gilbert, whose discoveries in magnetism have, I believe, been scarcely superseded at the present day. He accords no just tribute to Harvey, who had been his own physician. Harvey, on the other hand, appears to have set no great store by Bacon. Harvey is reported to have said :—"He writes on philosophy like a Lord Chancellor." Now that I have begun with Bacon's intellectual defects, I may as well finish with them. Bacon was strikingly deficient in the power of looking at things historically; indeed, it never seems to have occurred to him to do so. He treated Aristotle and Plato as if they were men of his own time, who differed from him in opinion. In his work called the *Wisdom of the Ancients*, he undertakes to show that under each of the fables of the Greek mythology there was wrapped up and concealed some piece of physical, metaphysical, or political philosophy. His interpretations of the myths are rich in ingenuity, but at the same time they are perfectly arbitrary and reckless; and they ignore the primary question of all, which is, How are we to conceive myths originally to have been formed and established in the minds of a people? To this question the quite recent science of comparative mythology offers some sort of solution. Bacon's view of the myths was very prosaic; he regarded them as didactic stories for the improvement of child-like minds. His view of poetry itself is of the same character. He describes it as "a part of learning," and evidently values it only so far as it is useful—that is to say, didactic. It is with a covert sneer that he says :—"Poesy was ever thought to have some participation of divineness, because it doth raise and erect the mind, by submitting the shows of things to the desires of the mind; whereas reason doth buckle and bow the mind unto the nature of things." He divides poetry into Narrative, Representative, and Allusive. In speaking of Representative poetry — that is, the drama—he makes no mention of Shakespeare, whom indeed he did not appreciate. He cares most for Allusive poetry, which conveys truth under the form of allegory. He excluded Lyrical poetry from the category of poetry altogether. He says :—"We exclude satires, elegies, epigrams, odes, and the like, from our discourse, and class them with philosophy and the arts of oratory." In short, Bacon, though he had himself many of the characteristics of a poet, utterly misconceived the true nature of poetry, and in his theory reduced it to the level of prose.

It is perhaps more excusable in Bacon that his outlook on the future of human knowledge was, after all, quite limited. He admitted that the instauration of the sciences would require some ages for its completion; but he thought that, within the compass of no very long period, that completion would be effected. Bacon would not have realized what was implied by Goethe's phrase, *unendliche Natur*. If you had asked him, he would probably have prophesied that, before the year 1877, all the mysteries of nature would have been cut and dried and garnered. He had some dim notion of the science of chemistry; of the sciences of geology, palæontology, comparative philology, and political economy, which have done so much to change modern ways of thinking, he had not an inkling. Of the theory of evolution or of spectrum analysis, it is needless to speak. Bacon had not even heard of gravitation, and he held to the Ptolemaic system of the universe. After all, men's imagination is restricted to what they have had experience of, or to some short flights of analogy beyond it, and we cannot in the least anticipate or set bounds to what our successors may be thinking of some few centuries hence.

Bacon has been charged with having led the way, by his philosophy, to empiricism, materialism, positivism, and sundry other amiable "isms." But this charge is rather unfair; for though, in his physical philosophy, he seems to have tended more and more to an atomistic theory, and though in the interval between his *Advancement of Learning* and his *Novum Organum* he seems to have abandoned the idea of metaphysics as a useful science, still he himself always maintained a great respect for revealed religion. Though he, very properly, enjoined that ethics should be studied, like other sciences, inductively, he considered that mind itself is an emanation from God, and not subject to the laws of science. He thus, as Kuno Fischer remarks, entertained a dualism not dissimilar to that of Descartes. He held that faith should go side by side with science, and that we should "render to Cæsar the things that are Cæsar's, and to God the things that are God's." Therefore, if subsequent philosophers have taken a different attitude, the responsibility surely rests with themselves.

The last reproach against Bacon is, that he made no discoveries himself, and that he directly led the way to none. Both of these allegations are, in fact, undeniable. Bacon sometimes showed brilliant intuitions into the nature of things; for example, in illustrating his method of discovery by "prerogative instances," he says:—"The phenomenon of colour is discovered most readily, and with the least heterogeneous admixture, in prisms, crystals, and dew-drops; for these have little or nothing in common with other coloured bodies, such as flowers, stones, metals, varieties of wood, &c. They are, in this respect, single instances, and from observing them we easily arrive at the result that colour is nothing but a modification of the image of the incident and absorbed light; in the former case by the different degrees of incidence, in the latter by the textures and various forms of bodies." This paragraph has been said to contain an anticipation of Goethe's theory of colours. But such intuitions were only, like those of Aristotle, the happy thoughts of a powerful intellect. Discovery, properly so called, remains as the prerogative of the specialist; and Bacon, though he killed himself by the experiment of stuffing a fowl with snow, cannot claim any discovery as his own.

Nor have discoveries been made by following the precepts of the Baconian method of induction. Some attribute this to the incompleteness of the second part of the *Novum Organum;* others say that it is because Bacon's method is based on an erroneous view of causation. Twenty years ago, Dr Whewell brought out a *Novum Organum Renovatum,* to supply Bacon's deficiencies; but we may safely venture to assert, that Whewell's book will not be a bit more fertile in producing discoveries than Bacon's has been. Logic is a useful part of education, and is necessary as a part of philosophy; but every real worker in the world seems to have an unconscious logic of his own, based on innumerable analogies of the class of facts with which he is in the habit of dealing. The study of deductive logic will never of itself create powerful reasoning in the law courts or the senate; and let the logic of inductive method be laid down never so perfectly, still discovery and the advancement of science will go on independently of it. The true method of studying nature had come into the world before Bacon wrote; it had been distinctly described, though in general terms, by Lionardo da Vinci, Tycho Brahe, and Galileo; and, quite independently of Bacon, its adoption had been signalised by several of the greatest discoveries ever made by the human race,—some of which Bacon even refused to admit. Probably no direct connection can be established between the influence of Bacon and the achievements of any separate science. But, as De Jouffroy says, "Is it nothing to have seized, at the critical moment, the idea which would open a new era to the sciences? Is it nothing, in the early dawn of an immense revolution, to have predicted almost in detail its career? Before Bacon's time no one seems to have had a true sentiment of the grandeur of nature; this sentiment, conjointly with enthusiasm for science, he preached and spread abroad. As soon as he had written, the genius of observation raised its head, and marched on an equality with the genius of thought."

I have already given evidence of Bacon's general influence upon the minds of men, and it was by this general influence, on the universities, on separate scholars, and on the reading world throughout Europe, that Bacon assisted the birth of the new era. His perceptive mind brought into one focus, beams of light which would otherwise have remained scattered; like an eagle he soared till he caught sight of the unrisen sun; he told the world what was going on and what was in store for it; he made the new era conscious of itself. In doing this, he employed the most splendid literary faculty. No architecture is, after its kind, finer than the English prose of Bacon's *Advancement of Learning.* Remusat justly recognises in Bacon's writing that quality which is termed "the great manner," and he envies him that balance of imagination with good sense, which he considers to be a specially English characteristic. Bacon, in an interval of short-sightedness, distrusted the permanence of the English language; like Dante, and others of the great moderns, he undervalued the worth and inherent vitality of his vernacular tongue; he said "these modern languages will one day play the bankrupt with books." Therefore, after his first great treatise, he preferred to write upon philosophy in Latin. This we may now regret from a literary point of view, but it doubtless extended the circle of his contemporary readers, and his Latin writings, not being in classical style, and being full of pregnant thoughts, wise and witty sayings, and the happiest metaphors, are easily translated into any language, and are a treasure for all the world. In conclusion, it is as an inspired seer, one of the greatest of men of letters, and the prose-poet of modern science, that I reverence Lord Bacon, and have ventured to make him the first topic of the evening.

Our own Royal Society doubtless borrowed its title and partly its idea from the Royal Society of London. I am proud to think that this Society is an emanation from the University of Edinburgh, from which it sprang, on the suggestion of Principal Robertson, in the latter part of 1782. Thus, in the same year when the University will celebrate its tercentenary, this Society will be able, perhaps conjointly, to celebrate its hundredth birthday. But in one essential particular we differ from the Royal Society of London, whose function was thus defined in 1663 :—"To improve the knowledge of natural things, and all useful arts, manufactures, mechanic practices, engines, and inventions, by experiments (not meddling with divinity, metaphysics, morals, politics, grammar, rhetoric, or logic)." These exclusions form no part in our constitution. On the contrary, from the first, the promotion of literature as well as science was the object of the Royal Society of Edinburgh. I may say, then, that the name of Bacon, as one of the greatest stars of literature, has a double claim upon our regard. But it has been observed that the literary element in our proceedings has been gradually dwindling away. Principal Forbes, fifteen years ago, spoke of the difficulties under which we laboured owing to a change in the manners of society, and to our having become less "clubable," or less intellectually sociable, than our ancestors used to be a hundred years ago. And he exhorted the then fellows to bestir themselves in the production of papers. I have inquired the number of papers, not connected with physical science, which have been contributed during the last fifteen years, and it appears to be considerably less than forty, or little more than two per annum. And of these, seven were contributed by Professor Blackie on classical or philosophical subjects, four by Lord Neaves chiefly on philology, three by Dr John Muir on Indian antiquities, three by Mr Wyld on metaphysical topics, two by Sir James Simpson on archæological questions, two by Mr Skene on Celtic topography and philology, and the remaining twelve or fourten by separate individuals. Thus, in the last fifteen years, out of about 370 Ordinary Fellows of the Society, only about twenty have come forward to contribute papers other than physical or mathematical. During the last session not a single paper on any literary subject was read before us. No doubt, there is much excuse for this, in the fact that the time of literary men is often much occupied, and that they can obtain a high remuneration elsewhere for the produce of their labour. It was doubtless owing to this that Sir Walter Scott, who was for twelve years President of this Society, never appears to have contributed a single paper to it, though he was so full of history and archæology and lore of all sorts.

The day may even come when the general public is sufficiently instructed to receive with interest, in ordinary periodicals, the physico-mathematical papers, which form the staple commodity of this Society, and then we shall have done our work. In the meantime I would venture, like Principal Forbes, to advocate "intellectual clubability." All tentative essays, which are not yet ripe to form a book or an article, may fitly be contributed to this Society and embodied in its Transactions, and I should have thought that not a single professor of any department in the University could go through the teaching of a session, without coming across at least some one novel point, which it would be worth while to bring forward.

In the course of last session, one of the three prizes in the gift of this Society—the Macdougall-Brisbane prize, consisting of a Gold Medal and £15, 14s. 7d., was awarded to Mr Buchan, for his paper, "On the Diurnal Oscillation of the Barometer." This important contribution to meteorological science has been published in the Transactions of the Society, and I note here with pleasure the words used in regard to it by our President, on presenting the prize:—"That it paves the way for discovering the complete thermodynamic theory of its subject, and that Mr Buchan has well followed up his laborious and most useful investigations of the meteorology of Scotland by so valuable a discussion of barometric observations from all parts of the world, collected and arranged in the very best manner for the immediate application of the harmonic analysis."

The following statement, in regard to the number of the present Fellows of the Society, has been drawn up by the Secretary :—

1. Honorary Fellows :—

Royal Personage—

His Royal Highness the Prince of Wales, . .	1

British Subjects—

John Couch Adams, Esq., Cambridge ; Sir George Biddell Airy, Greenwich ; Thomas Andrews, M.D., Belfast (Queen's College) ; Thomas Carlyle, Esq., London ; Arthur Cayley, Esq., Cambridge ; Charles Darwin, Esq., Down, Bromley, Kent ; John Anthony Froude, Esq., London ; Thomas Henry Huxley, LL.D., London ; James Prescott Joule, LL.D., Cliffpoint, Higher Broughton, Manchester ; William Lassell, Esq., Liverpool ; Rev. Dr Humphrey Lloyd, Dublin ; William Hallowes Miller, LL.D., Cambridge ; Richard Owen, Esq., London ; Thomas Romney Robinson, D.D., Armagh ; Lieut.-General Edward Sabine, R.A., London ; Henry John Stephen Smith, Esq., Oxford ; George Gabriel Stokes, Esq., Cambridge ; James Joseph Sylvester, LL.D., London ; Alfred Tennyson, Esq., Freshwater, Isle of Wight, ...	19

Foreign—

Claude Bernard, Paris ; Robert Wilhelm Bunsen, Heidelberg ; Michael Eugene Chevreul, Paris ; James D. Dana, LL.D., Newhaven, Connecticut ; Alphonse de Candolle, Geneva ; Heinrich Wilhelm Dove, Berlin ; Jean Baptiste Dumas, Paris ; Charles Dupin, Paris ; Elias Fries, Upsala ; Professor Carl Gegenbaur, Heidelberg ; Herman Helmholtz, Berlin ; August Kekule, Bonn ; Gustav Robert Kirchhoff, Heidelberg ; Herman Kolbe, Leipzig ; Albert Kölliker, Würzburg ; Ernst Eduard Kummer, Berlin ; Johann von Lamont, Munich ; Richard Lepsius, Berlin ; Ferdinand de Lesseps, Paris ; Rudolph Leuckart, Leipzig ; Joseph Liouville, Paris ; Carl Ludwig, Leipzig ; Henry Milne-Edwards, Paris ; Theodore Mommsen, Berlin ; Louis Pasteur, Paris ; Prof. Benjamin Peirce, United States Survey ; Henry Victor Regnault, Paris ; Angelo Secchi,

Carry forward,	20

Brought forward,	20	
Rome; Karl Theodor von Siebold, Munich; Bernard Studer, Berne; Otto Torell, Lund; Rudolph Virchow, Berlin; Wilhelm Eduard Weber, Göttingen; Friedrich Wohler, Göttingen, . . .	34	

2. Non-Resident Fellow under the Old Statutes:—

Sir Richard Griffiths, ...	1	
Total number of Honorary and Non-Resident Fellows at November 1877, ...		55

The following are the Honorary Fellows deceased during the year:—

Foreign—Urbain Jean Joseph Leverrier, John Lothrop Motley, ...	2	
British—William Henry Fox Talbot, ...	1	
		3

3. Ordinary Fellows:—

Ordinary Fellows at November 1876, ...		363
New Fellows, 1876–77.—Dr Isaac Bayley Balfour; George Broadrick, Esq.; George Cunningham, Esq.; Dr John Gibson; Walter Noel Hartley, Esq.; William Jolly, Esq.; James King, Esq.; Robert A. Macfie, Esq.; Sir Daniel Macnee; Dr Robert Milner Morrison; John Murray, Esq.; John Napier, Esq.; George A. Panton, Esq.; Dr William Pole; Prof. James Roberton; George Carr Robinson, Esq.; James Stevenson, Esq.; Prof. William Stirling; Charles E. Underhill, Esq.; Walter Weldon, Esq.; Charles Edward Wilson, LL.D., ...		21
		384
Deduct Deceased.—Dr James Bryce; Andrew Coventry, Esq.; Rev. D. T. K. Drummond; Sir David Dundas, Bart.; William Keddie, Esq.; The Hon. Lord Neaves; James Thomson, Esq., C.E., who died in August 1870, but whose death was only intimated in August 1877,	7	
Resigned—Dr Alexander Hunter; Captain T. P. White,	2	
Carry forward,	9	384

Brought forward,	9	384
Cancelled— Prof. Arthur Gamgee, M.D.; Ernest Bonar, Esq., cancelled in 1856, and whose name has been inserted by mistake in subsequent Lists, . .	2	
		11
Total number of Ordinary Fellows at November 1877, .		373
Add Honorary Fellows and Non-Resident Fellows, .		55
Total Ordinary and Honorary Fellows at commencement of Session 1877–78, ...		428

The following Obituary Address was read by Professor Piazzi Smyth, Astronomer-Royal for Scotland:—

Le Verrier—Urbain, Jean, Joseph—one of our most respected HonoraryMembers for thirty years, died on the 23d of last September, aged sixty-six.

On the 23d of that same month, but in the year 1846, an astronomical discovery was made on the Continent, which almost took men's breath away for the moment in astonishment and admiration; and which in bringing the name of Le Verrier for the first time prominently before the general public, taught them that the age of intellectual giants after the manner of Newton and La Place, was not yet closed. And thirty-one years afterwards, or on that very identical day of September in the present year 1877, the electric telegraph flashed this other mournful news over an attentive world, that the same Le Verrier (without compare the greatest gravitational astronomer of our time) had ceased to exist!

Death has been indeed too complete, for within a few days of Le Verrier's own demise, his adored Wife followed him to the tomb, where one of his sons was already laid; and we thus have the whole life-lesson of this most eminent scientist ready for impartial historical treatment, if at all.

But who shall prove equal to the task of writing the life of *such* a man. Biographical notices of him innumerable have been published, but *not* the one, full, history which posterity will require; nor is this the place to attempt anything of the kind. But what *has* appeared in print already, *sur*-abundantly relieves your Council of the necessity of any attempt on their part at formally *justifying* their advice of thirty years ago, to the Society, to enrol the name of

Le Verrier amongst its Honorary Members; and they cannot perhaps do better in the few minutes now accorded to them, than simply to describe something of the general character of, as well as progress of alteration with time in, the public career of the departed.

The *first* period of Le Verrier's virile existence may be considered to extend from his leaving the Polytechnic School in 1831, to receiving the appointment of Director of the Observatory of Paris in 1853; a joyous, a rising and expanding existence to him the whole of the time. Born in 1811 at St Lo, in the Department of Manche, (which courts the west wind of the Atlantic along the whole extent of its coast), and son of a Government official there, the young Le Verrier had received his education first in provincial, then in Parisian, schools, always manifesting a taste for, and superior power in, pure mathematics; but with a further determination also to hold his own course, and to prosecute his own *excelsior* ideals therein. Hence, on ceasing to be a college student in 1831, and beginning his career as a man, as the architect too of his own fortunes to be, he seems to have chosen, not a poorly paid, over worked, hard scientific post, but the more easily executed, and better paid employment of the ordinary civil service of his country; selecting such a branch therein as should leave him most spare time for the prosecution of his private reading; and only when, after some years, the further continuation of that official employment, the *Administration des Tabacs*, would have obliged him to leave the neighbourhood of metropolitan libraries,—did he seek to support himself by teaching mathematics, of which he then became one of the assistant professors in his old Polytechnic School.

But those pedagogic labours by day, the still youthful Le Verrier never allowed to interfere with his own private studies at night. He had already comprehended and fervently accepted his destiny; *viz.*, to succeed La Place in those applications of the higher mathematical analysis to celestial mechanics, which demand as much of continued labour, and power of abstraction, as of penetration, genius, and analytical resources. Hence his earliest paper presented to the Academy of Sciences in 1839, attacked no less than the secular inequalities in the movements of the principal planets. His second paper took up the orbit of Mercury, and the most exact calculation of the numerical amounts of the perturbations it is subject to from other planets. His third paper, presented in 1844, investigated in the most masterly style the perturbations which the strangely deflected Comet of 1770 must have experienced both before and after that epoch, from the attraction of the planet Jupiter. And his fourth paper, applied similar mathematical calculations to the more modern discovered Comet of 1843.

But those Comet papers, though they gained Le Verrier a seat and a pension in the Academy of Sciences, were not altogether in his destined line. In more immediate resumption of which, it was, that in the beginning of 1846, he brought before the Academy his fine investigation into the orbit of the planet Uranus, his computations of every perturbation it could suffer from every known member of the solar system, and his finding them all insufficient to account for the difference between theory and observation. And then, after that essential clearing of the ground, he produced his further and most remarkable of all his mathematical calculations, confessedly and by its very title, *on* "the hitherto unseen, outside planet, which, acting from without, *is* producing the apparent irregularities in the movement of Uranus, from a distance of 1500 millions of miles beyond, and *is* now in such and such a position in our sky, and *must* have such and such an apparent diameter." A note of that position and size Le Verrier sent to a German observer on the 17th of September in that year, 1846. That observer, Dr Galle by name, looked for it on the evening of the 23d of that month, and within a few minutes, with the powerful and accurately mounted equatorial telescope of the Berlin Observatory, he actually succeeded in finding Le Verrier's theoretical planet, since called Neptune, in the given direction, at the enormous distance and of the indicated size, nearly.

This was the discovery, *sensational* it has been called, but most worthy to make a sensation throughout the whole human race, which immediately brought in honours of every kind, and from many nations to Le Verrier. Which presently too, wafted him in political safety across the abyss which proved fatal to the then king and all the royal family of France; but gave the astronomer-mathematician an eminent place under the subsequent republic, and a still more eminent one under the Empire which followed. But none of those things, however flatttering personally, not even the powers invested in him to reform the Polytechnic School, and to inspect all the universities of France, nor all the immense astronomical correspondence of which he became the European centre, did he allow to interfere with his continued private research in his own appointed task. Wherefore the Academy was electrified again and again by further of his magnificent *planetary* papers, in 1849, 1850, and 1853—as, on new methods of constructing the numerical tables required for practically computing the places of the planets as subjected to all perturbations of Newtonian gravitation origin; next, on improved tables of the Sun, as representing the movements of the earth; and then on still more refined theoretical considerations touching the whole group of planetoids, between Mars and Jupiter, whatever their teeming numbers might eventually be found with the telescope.

All this time, too, Le Verrier was the most cheerful of beings, the most admired of all in scientific life, and envied by no one; for he had gained his successes by genius and force which were all his own, which no one else could attempt to claim or compete with. And he could be so smiling, so gracious, sweet as summer air, and full of happy remarks to all he met. Occasionally even rather too much so; for we have seen him at that period of his life at a meeting of the Academy, and while the very Perpetual Secretary was reading out the papers of *others*, there was M. Le Verrier joyously walking in, and about, and through all the ranks of seated savants, nodding to one, discussing with another, laughing with a third, proposing problems to a fourth, and without the slightest idea he could be doing anything wrong. While his personal appearance was in those days a tall figure, with fine upright carriage, sparkling eyes unconscious of offence, an immense dome of a head and abundant flaxen hair. The French called it "blond:" and how that man could have escaped being born an Anglo-Saxon, was more than we could then understand.

So closed the first period of Le Verrier's career; for the second and very contrasted part of it began when Louis Napoleon appointed him to the charge of the Imperial Observatory at Paris.

And why should it have been such a contrast? Was not the "Observatoire" just the place for such a man? Not a bit of it!

In our own Mrs Somerville's autobiography, unfortunately not then published, she pointedly records that when all the world was paying *her* honour, immediately after the publication of her most unexampled lady's book on astronomy, entitled "The Mechanism of the Heavens," elucidated there by her able expositions of the algebraical analysis of La Place and other great French mathematicians—one of her lady friends in Burntisland remarked so confidently, "Oh! Mrs Somerville, what a happy life you must lead, for of course you are always gazing at the stars through a telescope!" Whereupon Mrs Somerville answered to the effect, "that she had never looked through a telescope in her life, except once; and then it was not at a star." And of course! For if she had been spending her nights in instrumental star-gazing, how could she have been also getting up by midnight oil the totally different subject of algebraical equations?

Very similar too, *mutatis mutandis,* was the case of Le Verrier. Born to excel in astronomical mathematics on paper, what had he to do with telescopes! Why, the very, and most particular, praise which all the world had given him in 1846, was,—"Other astronomers have occasionally discovered a little planet, by finding in the sky with their telescopes a diminutive star, which varies its place slightly from night to night: but here, in M. Le Verrier, is a man who has discovered a planet without looking through a telescope at all; without even casting a single glance at the sky; *he* saw his grand planet at the end of his pen!" If that praise, then given so freely, was genuine and honest, why take that man away from his glorious pen work, and make him begin mechanical operations which he has no taste for: which he has shown he can transcend in their occasional results by totally different methods?

But the imperial will had ordained it; and forthwith, from 1853 to 1870, Le Verrier was known as *Director of the Observatory of Paris:* showing too, there, in many brilliant respects, how much a rigid sense of mere duty may enable a man to perform in almost any line. Though the world at large will be thankful chiefly, that in all this second portion of his career, Le Verrier never allowed himself to be entirely absorbed in the continually increasing circle of his official employments; but held as closely as ever to his soul's private task, viz., the mathematical investigations, and then the practical computations, of every perturbation which the Solar planets can suffer.

In this manner, with an energy, a constancy and an intellectual power never combined before in any one individual, Le Verrier had, by the year 1868, produced new tables of all the inner planets from Mercury to Mars; and in the course of them had demonstrated most unexpectedly, that the hitherto universally received quantity for 70 years past, of 8·56″ for the Solar Parallax, was much too small. The effect on the astronomical world was magical. For years there *had* been a languid idea that the Solar Parallax value derived from the then last previous Venus Transit, should be improved upon by observations of Mars at opposition; and the *Nautical Almanac* had for half a century gone on publishing the appropriate ephemerides of Mars and stars near him for Opposition after Opposition. But few persons ever observed them; or if they did, and also, like Henderson at the Cape and Taylor at Madras, computed the results as well,—they were not attended to. But the moment it was announced that Le Verrier had found from his calculations in Physical Astronomy, that the mean Solar Parallax was so far from 8·56″ as to be nearer to 8·95″, all Astronomical Associations were shaken to their very bases. Greenwich ran to court the new quantity. The *Nautical Almanac* adopted it with fervour: and half a dozen nations were presently competing with each other in observing and re-observing Mars' oppositions, and always finding now that they gave out a quantity very like the Parallax announced by the great Gravitational Astronomer of France.

But how went on things in general at the Observatoire, all this time?

For a while, wonderfully well! If Le Verrier had no practical experience himself, he knew where he could obtain it in others. So, the Emperor always aiding and abetting, the favoured savant had only to propose schemes of improvement, and the means in both men and money were always forthcoming to carry them out. *First,* the whole Greenwich system was imported bodily, its instruments imitated, its routine copied, and observing astronomers and computers of a like order procured. Then came the concentration of Meteorological Observations by electric telegraph from all quarters of Europe, and the issue of a daily Bulletin, post free to all the world, by another corps of practical scientists newly incorporated into the establishment. Then came the rise of the "Association Scientifique de France," a voluntary popular institution after the British model, but where *all* the sciences were taken up, and Le Verrier was President of everything.

He took care verbally and with semi-military *hauteur*, to appoint his Observatory subalterns their tasks to perform; but when these *were* performed, largely by the native and peculiar, and often most exalted, skill of the workers, *they* were pushed into obscurity on every great occasion, and Le Verrier took sole ostensible authorship of all their doings. Long had they borne, but how much longer were they to continue to bear, this peculiarly affronting tyranny? To perform the most exquisite work in their own lines, but to remain unknown, trodden on, and see another, who in his heart despised such things, gain all the advantage and all the credit? Feelings, though silent, were growing more bitter and dangerously exasperated day by day at the Observatoire. Something must come of it. At length, not there, but at the Academy, the malcontents found a leader in M. Delaunay: a younger man, but rising to be a still greater mathematician in gravitational astronomy, than Le Verrier himself: and yet at the same time, was this most unique and estimable Delaunay as much distinguished by natural amiability, by the sympathetic tendencies of his disposition, and his earnest regard for others, as the Director of the Observatoire, Imperial Lord of the Ascendant, was daily becoming more and more antipathic, as well as impatient of every one in the world but himself.

Now Delaunay's grand mathematically scientific work at that period was the theory of the Moon; and he too had come therein on certain equations whence he drew a new value for the Solar parallax; making it however more nearly 8·85″, and proving Le Verrier's 8·95″ quite inadmissible. So thereupon the two great mathematicians crossed swords. Their discussions, meeting after meeting of the Academy, attained a vigour and an intensity which drew half Paris to *assist* at these re-unions; but chiefly to hear Le Verrier! He was indeed rather in the wrong scientifically; and had, long afterwards, to modify his 8·95″ to something very close to Delaunay's numbers. But what did the crowd care for minute exactitudes! They went to see how a hero fights, how he gains his successes; and Le Verrier gave them plenty of that. Though not exactly an orator, he was clear in expression, fluent in words, and ready, aye ready, at a moment's notice. Rich too in cutting sarcasm and scarifying irony, he taunted the slowness of his opponents who had to go home and think over their replies and promise to give them at the *next* meeting of the Academy,—while he stood there having answered, or at all events confounded, them on every point yet produced; he, the man of peace, who desired nothing so much as to finish the war then and there.

On such occasions Le Verrier seemed to float in positive pleasure through the combat, cutting down his enemies with ease on every side. A smile was still on his countenance; but it was now the smile which opens not the lips; a distorting, disdainful smile, betraying however within, both the consuming fires of egotism, the love of conquering, and the voluptuous rapture of triumph become a necessary accompaniment of his existence. Yet there was this untoward feature about it all the time, that with every successive conquest, Le Verrier was making a wider and wider void around himself; until, with one dazzling victory more,—there came the deadening news, that every one had left him, and the Director of the Observatory reigned over telescopes alone!

The Minister of the Interior then had to step in and give such a disorganizing Director his dismissal. Le Verrier answered by a passionate appeal for an interpellation by the Senate: but that body supported the Minister, and the tyrant-mathematician had to go. He fell; and never had there been such a catastrophe known before throughout the scientific world. But Delaunay was immediately appointed to the vacant place; the observers, computers and artisans all returned, and the public service flowed on once again.

Time passed; and how heavy a time for France, after that affair of the Observatoire in the beginning of 1870. The terrific Franco-German war began soon afterwards; the Germans invaded France with a larger army than the world had ever heard of since the days of Xerxes, and, though professing to be "Christians," and calling their country "Holy," yet armed with infinitely more terrible means for the destruction of human life than his, or Mahomet's either.

Every battle went against the French; their smaller armies were annihilated, their fairest provinces rent away: their revenues sacked, their people (even innocent and peaceable men, women, and children) starved to the very bone, their capital city taken. And then, after all these destructions from without, poor Paris fell into the hands of her own revolutionary Communists; who, when at length attacked in their turn, by the recovered forces of the nation,—most provokingly insisted on making the very Observatoire of Astronomical Science, one of their chief strategic points of defence; drawing down thereby on the grand old building, from loyal French guns too, an amount of cannon shot that riddled the Equatorial Domes through and through, and ruined much of the substantial masonry below.

But the chief part of the daily service of the Observatory was not impeded thereby. For, with remarkable prevision of coming events, Delaunay had removed a division of the working staff, long before the siege of Paris began, to a Southern Department. There they gathered up the telegraphic communications again, there they carried on their collections of all European, with a few Asiatic and some African Meteorological observations, and there also, without the cessation of a day, they issued their daily lithographed Bulletin; contriving still to give to all nations, and by a free book-post, the earliest information of every scientific event and Natural change and thus to keep up their beloved France (though bleeding from unnumbered wounds) an intellectual centre, a heralder of the way, for all the learned world.

That grand result, however, came about mainly because it was Delaunay who directed, or rather bound together with cords of love, all the broken and scattered elements of the scientific service of France. Under his sympathetic lead, every one put forth his utmost powers, and with a will and a devotion which, in immediate presence of death, was almost sublime. And when at length peace returned, and the reorganisation of the Observatory of Paris had to be undertaken, every report which M. Delaunay addressed to the Minister of the Interior was as surprising for its pellucid clearness, as for its ably comprehensive character: alike too for including every department of science, as for insuring the distinct recognition of every good worker therein. A true and happy model Republic was the Observatoire thus becoming under this rare Savant's enlightened rule, tending to the American perhaps in its almost over abundance of personal liberty, but to the Athenian in its perfection of work and glorious ideals of still higher things to come,—when, on a day,—alack the day!—one most gusty, stormy, tempestuous day; when poor Delaunay, who had gone down to the sea-side merely for a short visit, essaying to cross the harbour of Cherbourg in an open boat, a squall came on, the boat capsized in deep water, and France's first, best, rising, genius was lost for ever.

All political and scientific society stood aghast. There was no second Delaunay to be had anywhere; and even those persons who had been most active in bringing him forward only two years before,—could do nothing now but tacitly consent, in their utter dismay, to Le Verrier returning to power again.

Le Verrier returned accordingly to the Observatoire in 1872, and then began a *third* distinctly featured period of his career.

No longer the cheerful-looking Anglo-Saxon man of his earlier days; nor the tall, stern, conquering figure of his middle career; but now, bent and feeble, with a dark, jaundiced hue overspreading his countenance (symptomatic of the disorder of the liver under which he finally sank), and with the muscles of his face half withered and shrunk down to the bone, so as to show the real osseous foundation of the countenance and prove him a born Gaul, after all,—Le Verrier in his third stage pleased both friends and foes less than ever.

With the latter he did not attempt any actual open war, but there was underground work going on all the time; mining and countermining; torpedo fighting of a very bad kind. *He* chafed in spirit that he was returned to power only by the accidental death of his grand, faultless, adversary; and *they* were vexed that their whole ranks contained not another man capable of openly meeting Le Verrier. *He*, dominating at the Parisian Centre, obtained from the Minister (who was now frightened to interfere with him) power to revise and curtail as he chose almost all the other scientific Observatories of the country; and *their* Directors were furious, that when France was, as then, a Republic, they, the scientist portion thereof, should have to live under the sway of a more than Emperor, a Czar;

of one, moreover, who, while indulging himself in extending *his* Observatory even by profuse public expenditure,—sought to gain a character before the country for economy, by starving, or even abolishing, their's.

If too, the claims of *some* of those other astronomers to patriotic recognition and govermental regard were occasionally too great to be altogether and immediately overborne even by Le Verrier,—he undermined, and laid plans which must *eventually* lead to their collapse and removal. Thus, was there a new Observatory lately established in the south of Paris, where the Savant, who had carried on the Meteorological bulletins during the German war, should in future devote himself to a new kind of utilitarian meteorology for the special benefit of agriculture and the service of the public health ;—or was there another new Observatory allowed to be built in the north of Paris at Meudon, near Montmartre, for the Savant who so nobly risked life and limb by sailing forth in a balloon over the heads of the truculent Germans then besieging Paris,—in order that France, even in her agony for very existence, should still be present among the nations at the observation of a total Solar Eclipse on the Northern coast of Africa,—and where, in that new Observatory, that patriot and fearless astronomer should, with no other control over him than the Minister of the Interior, seek to carry out his own very original inquiries into the Physics of Astronomy,—then Le Verrier insisted on having additions of new instruments and young subaltern observers added to his own Observatory, to accomplish the very same ends, but on a far grander scale. Or was there a new reflecting Equatorial ordered for the Observatory of Toulouse, —whereto M. Delaunay, in his short but brilliant career, had sent a young astronomer, of genius after his own heart, as Director,—Le Verrier did not actually interfere with its going there, but immediately ordered, at his country's expense, for his own Observatory, a similar reflecting telescope, one-half larger, and with all the economical fittings of the other in modest wood, replaced in his own with *ne-plus-ultra* work in fine metals.

And then his mere *manner* was sometimes so intentionally provoking.

When President Marshal Macmahon,—striving to entertain nationally, and mentally impress the Shah of Persia, then on his gorgeous visit to Paris,—applied to Le Verrier to arrange for a reception of the Eastern potentate and his bejewelled and glittering suite at the grandly restored Observatoire, he only received the following short note from the State's chief paid Astronomer :—

Marèchal,—La Science, n'illumine pas, les sauvages.

Le Verrier.

Even in ordinary conversation it was almost terrible to see how the old-man-misanthrope, in merely describing the course of an argument with another scientist, could egregiously clench his fist and act to the very life as though delivering a regular knock-down blow *right between the eyes.* Or when the other's equations were faultless, and no other complaint could be found, he would be stigmatised in society as "that man with the big ugly mouth."

All this would soon have become unbearable, but that it was accompanied by two things, even three, which induced wise men to be exceptionally tolerant.

First, for instance, they knew that there was still a truly heroic spirit in that querulous disposition and decrepit frame. When all the rest of educated society in Paris was utterly frightened at the sudden rise of the Red Republic, and sought only to strike their colours, and disappear by putting on the aspect of being more *canaille* than the Red men themselves,—Le Verrier stood out firm in his appreciation of hereditary order, historic experience, accumulated wisdom, and preservative rule. Red-republicans indeed claim to be equal to, and on the same level with, him ! Let any Red-republican of them all essay on the grandest test of man's intellectuality, to tread with him, if they could, the mathematical foundations of the stability of the Solar system ! And they couldn't :—so were *they* to inscribe their wretched shibboleth of "Libertè, Egalitè, Fraternitè" over his door? No ! he would have none of that sort of thing. And hence, when visitors from distant parts of the world, even from the very antipodes, came to pay their homage to the first physical Astronomer of France, and had been disgusted on passing through Paris, to see its grandest public buildings, and even the most sacred of its churches, scribbled all over, in fright, to pacify the Red men, with those three most falsifying, misleading words of their political creed and pretences,— such visitors read over the portal of the palace wherein Le Verrier resided, only this one word—"OBSERVATOIRE."

Second, within that respected building, in its private dwelling portion, *there* reigned the gentle radiance, and mild dignity of Madame Le Verrier.

In those early days of the now passed away French Emperor, when *he* made *no* mistakes, and had to pay his visit of state to London during the Crimean war, he not only took the Empress Eugènie with him; but, while M. Le Verrier was one of *his* suite, Madame Le Verrier was one of the ladies of honour in waiting on the Empress. One of the most mentally distinguished of them too; for, after the grandest West-end reception on that occasion, this saying worthily ran through the élite of London society, "Other ladies present were expensively dressed, but Madame Le Verrier was *well* dressed." And if there is any grim philosopher who doubts whether there is much in that, let him refer to the printed discussions on this very matter which took place at the Social Science Association's brilliant meeting at Aberdeen only two months ago.

But M. Le Verrier himself, amid all his wielding the forces of science, could appreciate the beautiful in art, and even assist at the development of some of its forms; for he fed his soul on music. But it was with a change, as his career progressed. When he visited England first, in 1847, and was asked to write something in a lady's album at Oxford, and not only composed a *chanson* then and there, but set it to original music, took a ruler, ruled the orthodox number of lines, and then wrote therein the musical notes with the precision of a copper-plate engraving,—the whole thing had the pleasant aspect of spring flowers; primroses and cowslips, daisies and buttercups in the opening months of the year. But when, as he felt impelled occasionally to do, in the long after years of 1875 or 1876, he armed himself with his violin and proceeded to draw therefrom, as it seemed almost in spite of itself, the most agonizingly beautiful strains, thrilling tones of dying grace,—tones which a Paganini might have envied, and ordinary men almost have wept that they could do nothing of the kind,—it reminded one more of the dark autumn's one, last, grand, garden flower, the Tiger-lily, bowing over its prospective grave in the earth beneath.

Lastly, in still further mitigation of much of Le Verrier's manner during the final years of his official career and life itself,—all good men were aware that his indefatigable, most original, and innate, unapproachable genius was again toilsomely engaged on the grand, self-imposed task of his life; and was even then rapidly and magnificently preparing as full mathematical theories and accurate practically-computing numerical tables of the larger, outer planets of the Solar System, as he had already done for the smaller, inner members thereof. His analytical methods too were the most comprehensive that had ever been attempted; and were specially distinguished by their capacity to take in and utilise all good observations ever made in practical astronomy on the bodies concerned, through all time, whether ancient or modern. The work was immense, and it killed him in the end, though not before he had satisfactorily finished it, even to the last page.

He had even the peculiar satisfaction before his death of seeing his most difficult researches, almost in mathematical darkness, as to the mass of the planet Mars—up to that time supposed by all the world to be "moonless Mars"—suddenly lighted up and confirmed by the splendid and most unexpected *American* discovery of this last summer, with their latest erected and largest equatorial telescope at Washington, of two moons circulating around that planet, and at rates of motion which admirably bore out his, Le Verrier's, intellectually concluded number for its mass and consequent power of gravitational attraction. But so truly immense, as well as *ultra* difficult, was the whole planetary research, that not only (as has been well said elsewhere) would it have been considered impossible for one man to have achieved the whole, if Le Verrier had not performed it in our own times,—but, only one man has been found fully able even to describe the work to others; and that one man is,—who?

Le Verrier's early, unconscious, but unexceptionable, and equally successful rival, in his greatest astronomical calculation, prediction, and discovery, with regard to the once unknown planet, which we all now so glibly call Neptune,—viz., the then young J. C. Adams, of St John's College, Cambridge.

Professor Adams has indeed not only described, in a late Presidential address to the Royal Astronomical Society of London, Le Verrier's life long problems of the planetary orbits,—with an ability, clearness, and method which leave nothing to be desired for scientific instruction's sake,—but he has thrown into the execution of his task such a plenitude of impartiality, such generosity of feeling and goodness of heart, that his account has been enthusiastically reproduced in Paris, within the last few weeks, under the title of "The genius of Le Verrier appreciated in England."

Such then, so far as this imperfect account can go, was *Urbain, Jean, Joseph,* LE VERRIER. That grand existency, who was lost to the ranks of the Honorary Members of this Society, on the 23d of last September; when his spirit returned to God who gave it.

In recording the lamented decease of the Hon. Lord NEAVES, we have to record almost the greatest loss which the "Literary class" of the Royal Society of Edinburgh could have sustained. When this sad event was announced in December of last year, a universal note of lamentation was raised throughout the city. It was felt that a great figure had been taken away from our ranks; that we had lost not only a learned and weighty Judge, but an accomplished scholar, a distinguished man of letters, a wit and a conversationist who contributed salt to all social gatherings, a racy Scottish character, and "one of the last links which connected the Edinburgh of to-day with the greater Edinburgh of the past." But the loss which the Royal Society has sustained in Lord Neaves is special and peculiar, for he was rarely qualified for a literary Fellow of this Society, and as such he bravely played his part and contributed his share to our Proceedings, and he has left very few behind who can be at all compared with him. Lord Neaves possessed not only great intellectual activity and a predilection for scientific research, especially into questions of philology, but he was also largely endowed with that quality which has been, on a former occasion, referred to as necessary for the maintenance of vitality in a Society like this—the quality of "intellectual sociability." He loved to communicate with others, to tell and to hear, upon topics of literature and science. We can all call to mind his genial manner, when presiding at meetings of the Royal Society, and the dry humour with which his scholarlike papers were interspersed. An exhibition of the same manner at one of the meetings of the Social Science Congress caused the late Sir John Bowring to give Lord Neaves the nickname of "Wit and Wisdom."

Lord Neaves, who was of Forfarshire extraction, was born in Edinburgh in the year 1800. He was educated at the Edinburgh High School, where he exhibited precocious scholarship, marked intellectual tastes, and that quick, capacious, and retentive memory, "wax to receive and marble to retain," by which he was distinguished to the very end of his life. He was *dux* of the High School in 1814; and then passed through the Edinburgh University with distinction, though it does not appear that he graduated —graduation not being the custom in those days. In 1822 he was called to the bar, which then included among its numbers a brilliant band of wits and scholars;—the walls of Parliament House then resounded with the talk and the laughter of Lockhart, Professor Wilson, Professor Cheape, Sir William Hamilton, George Moir, Patrick Fraser Tytler, and Patrick Robertson; while among the older generation on the Bench were Cranstoun, Jeffrey, Murray, and Cockburn. Of the spirit of those times Lord Neaves was the last representative. In 1841 he was made Advocate-Depute: in 1845, Sheriff of Orkney; in 1852, Solicitor General; in 1853, on the death of Lord Cockburn, he was appointed a Judge in the Court of Session; and in 1858 he became a Lord of Justiciary. The verdict of Lord Neaves' professional brethren upon his legal qualifications appears to be that he was a great "case lawyer"—his vast and accurate memory giving him peculiar facilities in referring to precedents, and that he was highly distinguished as a criminal Judge.

Side by side with the faithful discharge of his professional duties, Lord Neaves always maintained the part of the man of letters. From the year 1830 onwards he was a constant contributor, both of prose and verse, to "Blackwood's Magazine." He was the author of a series of articles, in that periodical, on Grimm's "Teutonic Grammar" and Grimm's "Philological Magazine," which excited much interest at the time, and the republication of which has often been urged. But his most lasting literary production will probably be his volume of "Songs and Verses, social and scientific, by an old contributor to 'Maga,'" which was first published in 1868. The motto of this volume might be "Ridentem dicere verum, Quid vetat?" In it playful and kindly satire appears in its best form, directed against the exaggerations, false sentiments, or fallacies of the day. And the songs themselves are so well written and so full of sparkling life that they may well continue to please many a future generation. His last published work was the "Greek Anthology for English Readers," and the preparation of this was with him indeed a labour of love. In it he was able to combine his scholarlike fondness for classical antiquity with his taste for the witty and the epigrammatic, and it afforded him infinite pleasure to labour at reproducing in the most terse and elegant English form the best flowers out of that garden of happy conceits and concinnities bequeathed to us by the Grecian muse. This work, though undertaken very late in life, was highly successful; the renderings were spirited, and they were accompanied with annotations, in which was much curious learning, very creditable to one with whom scholarship was not a business but a recreation.

Lord Neaves became a Fellow of the Royal Society of Edinburgh in 1856. In 1859 he delivered the opening Address of the Session, with a biographical notice of the venerable Principal Lee. Ten years later he gave another opening Address for the Session 1869–70. In the same session he read a paper on the "Primitive Affinity between the Classical and Low German Languages." In this paper he argued that the affinities between old English and Latin must have arisen from prehistoric identity or connection, and he pointed out certain limitations to which Grimm's law of affinities must be subjected. In 1871 he read a communication "On the Pentatonic and other Scales employed in Scottish Music," when airs illustrating his views were played by Mr Bridgman. In 1872 he read a paper on "Some Helps to the Study of Scoto-Celtic Philology," in which he pointed out the disguises which words belonging to the Aryan family of languages assume in passing into Gaelic, and showed the laws regulating those changes. Among other points of interest, the paper contained a discussion upon *so* and *do*, the Gaelic representatives of the Sanskrit prefixes *su* and *du*, which appear in Greek as εὔ and δυς—"well" and "ill."

In 1874 Lord Neaves furnished biographical notices of Lord Colonsay, Professor Cosmo Innes, and Mr Francis Deas; and in 1875 he read a paper "On some remarkable changes, additions, and omissions of letters in certain cognate European words." This paper dealt in a most interesting manner with the transformations of words, and showed the identity between many pairs of words in cognate languages, where the words themselves had grown to be widely dissimilar.

In this place we may surely say, "Quis desiderio sit pudor aut modus Tam cari capitis?" What he brought to us here from time to time was part of the stores which he was for ever gathering in his library, where during all leisure hours he would sit, with heaps of volumes about him, plunged and absorbed in books. In his house many of us have enjoyed his genial hospitality, where, surrounded by a bright and intellectual family, he was himself "a central warmth diffusing bliss," ever gay and radiant, a downright opponent indeed of all shams and false pretences, but yet with a large-hearted charity for all. Beneath a laughing exterior Lord Neaves concealed steadfast internal principles; the writer of this paper remembers the "sæva indignatio" with which, on one occasion, he turned upon a foreign gentleman who had uttered a flippant and infidel remark. In all the relations of life he was blameless, and by his example he has shown that it is possible to combine piety, learning, wisdom, and hard and successful work with kindliness, brightness, laughter and joy.

By the death of Mr Andrew Coventry, this Society, of which he had been for more than thirty-four years a Fellow, has lost one of the most amiable and accomplished of its members. Both Mr Coventry's father and his grandfather were men of mark. His grandfather was a Congregationalist minister of some eminence near Kelso; his father was the first Professor of Agriculture in the University of Edinburgh, and is spoken of in terms of admiration in the letters of Niebuhr, the great German scholar and historian, who at the beginning of this century was attending classes here. Mr Andrew Coventry was educated at the High School of Edinburgh, of which, when he left it, he was "second dux." He went through a course of study at the University, and seems to have paid particular attention to chemistry. In 1823 he was called to the bar, at which he made a good start, and was apparently rising, when, in 1840, he succeeded to the fortune of his uncle General Cuninghame, and relinquished professional pursuits. From this time forward he led the life of a *dilettante,* in the best sense of the word, for he really delighted both in science and in the fine arts, and exhibited no mean information in both these provinces. The first product of Mr Coventry's leisure, which has been preserved, consists in "A Letter to the Landed Interest of Scotland," advocating "the merits of the Association for employing an agricultural chemist." This pamphlet, which appeared in 1843, went through two editions. Mr Coventry travelled yearly on the Continent, taking great interest both in scenery and works of art; he collected, to a certain extent, both books and pictures, and in 1851 he had the good fortune to purchase in Westmoreland a very beautiful marble bust, which proved to be a genuine antique, and was pronounced by Mr Burgon of the British Museum to be the bust of Antonia Augusta, daughter of Mark Antony and Octavia, and mother of Germanicus and of Claudius. On this discovery Mr Coventry read a paper in 1852, being his first contribution to this Society. It may be mentioned that the bust itself is now the property of his nephew, Colonel Crighton. In 1854 he published anonymously a little treatise entitled "The Certainty of Christianity," which he maintained chiefly on historical grounds. In 1856 he delivered the "Ulbster Hall Lecture," on "Some of the most curious Inventions and Discoveries of Recent Times." This lecture gave evidence of very extensive reading and great fulness of knowledge as to the results of science, and the facts which it contained were set forth in a lively and striking manner. In 1857 Mr Coventry delivered the annual address to the students of the School of Design under the Board of Manufactures, and in so doing displayed the feeling and taste of a connoisseur. He always took a great interest in the Association for the Promotion of the Fine Arts; he was for many years a member of their managing committee, and more than once presided at their annual meeting. In later life, becoming a director of the Commercial Bank of Scotland, he began to devote himself to questions of finance, and in 1870 he read before us his second paper, which was entitled "A Method for Economizing our Currency." The idea was, that by demonetizing the sovereign and substituting for it notes, which should represent gold hoarded in the cellars of the Bank of England, a considerable saving might be effected in the wear and tear of gold. This idea, though ingeniously advocated, can hardly be said to have recommended itself to practical financiers. Of late, for many months before his death, Mr Coventry suffered from a painful and excruciating disorder, which he bore with manly fortitude and pious resignation. To the end he continued to solace himself as far as possible with his old pursuits. He was one of those who take a pride in always having read and being able to talk about the last new book. His conversation was always genial and interesting, and his loss has been felt in many circles, as it must also be in the Royal Society.

The next name in the obituary for this year is that of Sir DAVID DUNDAS, Baronet, a gentleman of that class who, without what has been called a "professional" acquaintance with science, art, or literature, are still acceptable members of a Society like this, if they show (as they must do by applying for admission) a sympathy for and interest in our pursuits. By their admission to be Fellows, a mutual compliment is at all events implied. Sir David Dundas was born in 1803. He was admitted an advocate at the Scottish bar in 1824, but never practised. He was a Deputy-Lieutenant for Perthshire, and lived the life of an active country gentleman, chiefly engaged in managing and improving his beautiful estate of Dunira. And he was respected by those who knew him as a most kind and honourable man.

By the death of Mr JOHN LOTHROP MOTLEY the Society has lost one of the most celebrated of its Honorary Fellows.

Mr Motley was born at Dorchester, Massachusetts, on the 15th of April 1814. He was educated at Harvard Unversity, where he graduated in 1831, at a very early age; after which he spent two years in Germany, residing successively in Göttingen and Berlin, and some additional time in travel in Italy and other parts of Southern Europe. On his return to America, he studied for the profession of the law; but, though he was called to the bar in 1837, he does not seem to have sought for practice. He had resolved rather that literature was his vocation. In 1839, at the age of five and twenty, he published a novel, called "Morton's Hope, or the Memoirs of a Provincial," which had little or no success, and is remembered now but slightly. In 1840 he was appointed Secretary to the American

Embassy in Russia; but, after having been for some time in St Petersburg, he resigned the appointment. Thenceforward, for nearly ten years, American biographical authorities represent him as living privately at home, engaged in miscellaneous studies and contributing miscellaneously to American periodicals. A second novel, which he published in 1849, under the title of "Merry Mount, a Romance of the Massachusetts Colony," had no better fortune than the first. Meanwhile he had been finding his true vein. The passion for history, apparent in the title and conception of this novel, had been manifesting itself more seriously and effectively in occasional historical essays. A review of Tocqueville's work on American Democracy and a paper on Peter the Great of Russia are mentioned as having attracted especial notice. By this time, indeed, it had became known among Mr Motley's friends that he had fastened on a great subject for elaborate historical treatment by himself. No one had adequately written the History of the Dutch People and their Commonwealth; there were affinities and attractions recommending this subject in a peculiar manner to an American of the United States; Mr Motley had been meditating these, and had determined to make the subject his own. To qualify himself by the necessary researches, he came to Europe again in 1850, and lived for several years at the Hague, and in Dresden and Berlin, immersed in documents. The result was the appearance, in 1856, when Mr Motley was forty-two years of age, of his "Rise of the Dutch Republic: A History," in three volumes. The work, published simultaneously in London and New York, was eagerly hailed by readers and reviewers on both sides of the Atlantic; translations of it into several European languages were at once begun; and the author at once took his place among the most eminent writers of his generation. Undisturbed by applauses and honours, Mr Motley persevered in his task. The volumes he had published, extending from the accession of Philip II. of Spain in 1555 to the death of William the Silent in 1584, had told only the story of the heroic revolt of the Dutch from the Spanish tyranny and of the triumphant foundation and beginnings of their little Republic of the Seven United Provinces. But, in 1860, there appeared the first two volumes, and in 1867, the last two, of what was virtually a sequel in four volumes, though it bore the independent title of "History of the United Netherlands from the Death of William the Silent to the Twelve Years' Truce, 1609." If of less riveting interest than the former work, these volumes were welcomed as of high historical value, and fully sustained the author's reputation. At the date of the publication of the first two volumes, and also at that of the publication of the last two, he was domiciled in London,—whence his two prefaces are dated; but, through nearly six of the intermediate years, he had been ambassador for the United States at the Court of Vienna, having been appointed to that important post in November 1861, and removed from it in 1867. On the accession of General Grant to the American presidency in 1869, Mr Motley was again in request for diplomatic service, and was made American minister in London. In consequence of some differences between him and the American Secretary of State, he retained the office only till November 1870. The rest of his life, which was passed mainly in England, though with visits to Holland, was devoted entirely to literary labour. In 1874, under the title of "The Life and Death of John of Barneveld, Advocate of Holland, with a View of the Primary Causes and Movements of the Thirty Years' War," he added two volumes more of Dutch history to his former seven, and brought his narrative down to the year 1623, when the farther fate of his beloved Dutch had became involved in the vast struggle between the opposed forces of Protestantism and Roman Catholic Absolutism all over Europe. It had been his intention to overtake this vast struggle too, and, in the form of an express history of the Thirty Years' War, to bring the Dutch safely through that great European entanglement, on to the Treaty of Westphalia in 1648, when, in the general pacification and winding up, the independence of the United Provinces was at last formally declared and guaranteed. This portion of his projected work he did not live to accomplish. He died, in an English country-house, on the 29th of May in the present year, at the age of sixty-three. Friendships and family connections, as well as tastes, had attached him much to England in his later years.

Mr Motley was a man of fine and stately presence, and of gravely courteous manners. Of his private life, as well as of his services as an American public man and diplomatist, accounts will probably be forthcoming in time. For the world at large, he lives, and will live, as the historian of the Dutch Republic. It was his distinction to have seized the great subject in the prime of his manhood, to have clung to it tenaciously through five and twenty years, and to have laboured assiduously all that while among archives and original authorities for the attainment of the adequate knowledge. It was no less his distinction to have infused into his treatment of the subject the glow and energy of his own personal convictions, the passionate and eloquent expression of his sympathies with the men and the principles that he believed to be in the right, and his detestation of those that he believed to be in the wrong, on a noted theatre of human action eight or ten generations ago. So far as there are differences of critical opinion about his writings, they chiefly depend indeed on the views that may be taken as to the limits of a historian's right to interweave his own moral and political approbations and censures with his narratives of the past. M. Guizot, who was an admirer of Mr Motley, thought that he went beyond bounds in this respect, and that his "alternations of extreme aversion and strong predilection" were irritating. The criticism has been repeated in England since Mr Motley's death. He had probably his own theory on the matter, and could have defended it well. It seems to have been an axiom with him that a historian, of competent knowledge and power of imagination, may trust himself to feel as accurately about the persons and transactions of three hundred years back as about those immediately around him, inasmuch as there are certain principles and tendencies of things that ought to be dear to all humanity, while their opposites are intolerable,—inasmuch as everywhere and in all times a Philip II. and all his belongings must be execrable, while a William of Orange or a Barneveld is to be honoured and revered. By acting on this view of a historian's duty, Mr Motley certainly increased the effect and popularity of his writings, and it does not appear that he subtracted from their permanent worth.

Shortly after the appearance of his first historical work, Mr Motley was elected a corresponding member of the Institute of France. He was also D.C.L. of Oxford, and LL.D. of Cambridge, Leyden, Harvard, and other Universities, Continental and American. He was elected an Honorary Fellow of the Royal Society of Edinburgh on the 1st of March 1875. We have lost him after a too brief connection.

The Society has this year to deplore the loss of one of the most eminent of its Honorary Members in the death of Mr TALBOT. It is very rare indeed to find a man who attains to anything beyond mediocrity in more than one or two departments of knowledge. Mr Talbot is a remarkable exception to the general rule. Seldom has the world seen so many-sided a man. He attained to distinction in pure mathematics, in physics, in chemistry, in astronomy, in archæology, and in literature; nor is his name altogether absent from the records of botanical research. After studying at Harrow, Mr Talbot graduated in Cambridge in 1821; and although his name appears on the honour list in mathematics, it does not occupy so high a position as his subsequent career would have warranted us in expecting. In fact, his early promise was eminence in classical literature, especially in Greek. As an undergraduate he obtained the Porson prize for translation into Greek verse of a selected passage from an English dramatic poet. This was followed at his graduation by his obtaining one of the two Chancellor's medals, awarded "to the graduates who show themselves the greatest proficients in classical learning." Linguistic studies, though he never abandoned them, had not that prominence in his after life which might have been expected from this beginning. The year after taking his degree we find him contributing to "Gergonne's Annales" a paper on a mathematical subject, which was followed up by others in the same serial; and from that time, for upwards of fifty years, there emanated from him an uninterrupted stream of original papers on mathematics, physics, astronomy, chemistry, and archæology, as valuable as they were varied. To take even a hasty glance at his most important researches would vastly exceed the limits of this necessarily brief sketch. We must not, however, pass by without a few words his great discovery in photography. So early as 1826 he had turned his attention to the chemical action of light. The results were communicated to the "Edinburgh Journal of Science" and other periodicals. In 1833, when sketching on the shores of Lake Como, he availed himself of the *camera lucida*, and it occurred to him that images might be fixed on the paper by chemical action. The idea was not altogether novel, but it had not as yet led to any definite result. On Mr Talbot's return to England, he commenced a series of experiments on the decomposition of nitrate of silver by light, which he continued for many years. In 1835 he had reached the length of producing images on paper by the *camera obscura;* but being anxious to perfect his discovery, he contented himself with issuing brief notices of the results in the "Philosophical Magazine" and the newspapers. It was not until the 31st of January 1839 that he communicated to the Royal Society the first of the papers on a process which will always be associated with his name. The paper is entitled "Some Account of the Art of Photogenic Drawing, &c." This paper was followed up, three weeks later, by a memoir, describing the process for preparing the paper, fixing the image, &c. The following year saw Mr Talbot's crowning discovery—that which virtually established the art as it now exists—the development of an invisible image.

Daguerre in France had been at work at the same subject, using metal instead of paper, and his discoveries were given to the world almost simultaneously with those of Mr Talbot, It is not necessary here to refer to the subsequent history of calotype. It was beautiful at its very birth, and its beauty was recognised nowhere more fully than in Scotland. Many members of the Society will remember how, soon after the discovery was made known, the process was employed by Dr Adamson and Mr D. O. Hill to the production of life-like portraits in a style which has never been excelled. The simultaneous inventions of the daguerreotype and the calotype naturally created jealousies on both sides the Channel. Mr Talbot found a warm and able advocate in Sir David Brewster. These controversies may now be consigned to oblivion. If the French did injustice to Mr Talbot in the early days of photography, they made amends at a later period. At the Paris Exhibition of 1867, the Commissioners awarded him the great gold medal for his contributions to photography, although he was not an exhibitor.

It must not be inferred from the prominence given to Mr Talbot's connection with photography, that his other contributions to literature and science were unimportant. It is far otherwise. In the most recent large treatise on the differential and integral calculus, that of M. Bertrand, the reader will find the name of Mr Talbot associated with those of James Bernoulli, Fagnani, and Chasles. Mr Talbot was one of the early promoters of the Society of Biblical Archæology, and contributed largely to their Transactions. Some thirty years ago, Mr Talbot, Sir Henry Rawlinson, Dr Hinks, and M. Appert agreed to decipher independently certain cuneiform inscriptions brought from Nineveh, and to compare the results. The comparison showed a general harmony amongst the four interpretations, but by no means an identity. Mr Talbot's genius was too original and of too high an order to fail of recognition. The Royal Society of London conferred on him both their Royal and their Rumford medal. It also assigned to him the Bakerian Lecture for 1856, the subject being "Further observations on the optical phenomena of crystals." Mr Talbot's contributions to our own Transactions consist for the most part of historical sketches or short papers on subjects lying on the borders of his early investigations; such are the papers on "Fermat's Theorem," on "Fagnani's Theorem," &c. Perhaps an exception to this remark may be found in the paper "On a new mode of observing certain spectra," based on experiments made in Professor Tait's laboratory. In his brief note on "Anomalous Spectra" he shows that he long ago anticipated the wonderful discovery of Le Roux and Christiansen, but was prevented from publishing his observations by the advice of Sir D. Brewster. In private life Mr Talbot was shy and reserved to strangers, but a lively and animated talker when in the congenial society of old friends, such as Sir David Brewster, and indeed of some younger men whom he honoured with his friendship. He sat for two years in the first Reformed Parliament. Of this he was reminded by Lord Palmerston, when in 1863 the University of Edinburgh conferred on these two men, so very unlike each other, the honorary degree of LL.D. Many honours from foreign societies were conferred on Mr Talbot, but it is not easy to record them, from the fact that, with the accustomed modesty of true genius, he shunned to display them.

He died September 17, 1877, in his 78th year.

Dr **James Bryce** was born at Killaig, near Coleraine, in the north of Ireland, on October 22, 1806. He was the third son of a Scottish Presbyterian minister, who had settled there three years before, and obtained the earlier part of his education from his parents, who were both, in somewhat different ways, persons of remarkable intellectual gifts and cultivation. At the age of fourteen he was sent to the University of Glasgow, where his father and his eldest brother had been before him, and where he graduated M.A., receiving from it in after life the honorary degree of LL.D. There he threw himself, with characteristic ardour, into the studies of the classes, winning, among other distinctions, the Greek Blackstone prize, which was then, and appears to be still considered, the most considerable honour awarded in the linguistic classes. Although he had been from childhood fond of nature and all natural objects, the bent of his mind towards science did not definitely express itself till he accepted, at the age of twenty, the post of head of the mathematical department in the Belfast Academy, then one of the chief foundation schools in Ireland, and of which his eldest brother, the Rev. Dr Bryce of Belfast (who is still living) was then Principal. Finding the teaching of geography to belong to his department, he at once saw what hardly any one had then seen, how important a branch of that subject physical geography constitutes, and perceived that to deal adequately with it a knowledge of geology and mineralogy was necessary. From these he was led on to zoology and botany, and not only threw himself into these topics himself with characteristic ardour, but formed large classes for their study, which were attended as well by his own pupils as by other young people in the town. At the same time he had begun to connect the teaching of natural philosophy with that of mathematics, explaining and illustrating by experiments the leading principles of mechanics, pneumatics, hydrostatics, electricity, chemistry, and other cognate branches of inquiry. We have listened to so many discussions during the last few years respecting the necessity of giving to natural science a regular and important place in schools and colleges, and now see so much actually done to effect that object, that it is hard to realize the state of opinion and practice in these matters fifty years ago, when such educational reforms were unheard of, and little beyond Latin and Greek was taught in all the best schools of the United Kingdom. It needed a very warm love for science, and a very elevated view of the functions of education, to lead a young man in those days to introduce, on his own idea, so great a change in the established method of instruction. An able teacher perpetuates himself through his disciples, and many eminent scientific workers trace back to Dr Bryce the first impulse towards, the first guidance in, the study of nature which they received. His services in promoting, by example and by argument, both in Belfast and afterwards in Glasgow, the introduction of these subjects into a school course can hardly be overestimated. While inspiring others with his own tastes, he had also begun to do valuable scientific work on his own account, partly in botany and mineralogy, but chiefly in geology. He investigated and described certain interesting fossil plant beds (similar to the leaf beds of Mull) occurring on the shores of Lough Neagh, and contributed to the "Philosophical Magazine" an account of the important discovery which he had made of the remains of the Plesiosaurus in the lias of Antrim, which conclusively established its identity with the lias series of England. Pursuing his researches into the geology of the northern counties of Ireland, he was the first accurately to examine and describe the structure of the remarkable basaltic formations on the coasts, and particularly of the Giant's Causeway. A series of papers contributed to the Journals of the Geological Societies of London and Dublin, of which he had become a Fellow in 1834, attest his activity in observation; while in Belfast itself he was one of the most active members of a local scientific society, which numbered many men of eminence among its members, and exerted a powerful influence on the culture of the town, now the most prosperous in Ireland.

He removed in 1846 to Glasgow, on being appointed head of the mathematical and geographical department in the High School of that city. Here, in a larger field, he continued the same enlightened system of science teaching which he had started in Belfast. He joined the Philosophical Society, was soon placed on its Council, and was for three years its president, delivering in that capacity addresses in which he reviewed the progress of scientific inquiry, and discussed some of the main problems now lying before it with a completeness and accuracy which supplies remarkable evidence of the width of his cultivation, as well as the keenness of his observing and reflective powers. There was scarcely a department of science of whose leading principles and method he did not show himself master, a remarkable achievement in an age when every study has become so much sub-divided. His geological work during this period lay chiefly but not exclusively in the Clyde basin and its surrounding mountain groups. Papers on the "Parallel Roads of Lochaber" and the "Glacial Phenomena of the Lake District of the North of England" were followed by a systematic treatise on

"The Geology and other Natural Phenomena of Arran," which has reached a fourth edition, and constitutes the most complete and satisfactory account of that interesting island.

Latterly he had devoted himself chiefly to the geology of the North-West Highlands—first to that of Skye and Raasay, afterwards to the determination of the age of those rocks in Ross and Sutherland which have excited so much discussion among our leading geologists. In several expeditions he had visited and examined the sandstones of Loch Torridon and the remarkable limestones of Assynt and Durness. It was while on his way northward to complete these investigations that he met, at Inverfarigaig, on the shores of Loch Ness, with the accident which closed his life, by the fall of a pile of loose rocks which he was trying with his hammer.

He was then (July 11, 1877) seventy-one years of age, but still in full strength of body and mind, with his interests in science unabated. He had come in 1874, on resigning his post at Glasgow, to live among us in Edinburgh, had been elected to this Society, and seemed likely to prove one of its most zealous and useful members, when he fell by a heroic death in the service of the science to which his energies and talents had been so long consecrated.

As an observer Dr Bryce was unwearied and careful, as a describer and lecturer eminently lucid and graphic. He had also the gift of being able to communicate to others his own enthusiasm, and it was in great measure this, joined to a warm and genial manner, that made him so successful as a teacher. His love for nature and her beauties rose to a passion rare even among men of science; a ramble among woods and mountains was always to him a pleasure far more intense than any which ambition could promise or wealth purchase. His intellect was indeed an imaginative one, as appeared both in the vivid descriptions of scenery which occur here and there in his scientific papers, and in his own love for poetry and the dramatic aspects of history, branches of literature to which he had been devoted from boyhood.

Although it is as a man of science that he was chiefly known, Dr Bryce took an active part in current questions, especially those relating to education. He was one of the first—perhaps the very first—in Scotland to insist on the necessity for a reform in the constitution of the Scottish Universities, and on the recognition of the right of the graduates to a share in their government, and he organised the first association formed for that purpose. He held strongly that the educational system of Scotland ought to preserve its distinctive character, instead of being administered from London and assimilated to that of England. Among minor reforms which he advocated was that of the introduction of a decimal system of coinage, weights, and measures, on which he wrote a short but weighty treatise.

Besides the geological writings already mentioned, he was the author of several educational books, such as treatises on algebra, geometry, and the elements of astronomy, and a cyclopædia of geography. Most of these have gone through several editions.

It only remains to add that Dr Bryce's gifts as a scientific writer and teacher were not more remarkable than the simplicity and charm of his character. He retained into old age not only the fire and freshness of youth, but a perfect sweetness of temper, and an ungrudging readiness to place his time and knowledge at the service of others, which advancing years seldom spare.

His memory as that of one of the most lovable of men will be long cherished by hundreds of former pupils, with many of whom, scattered through India and the Colonies, he kept up intimate relations, and by the large circle of scientific friends whom he was accustomed to meet year after year at the meetings of the British Association and of our own learned societies.

The Rev. DAVID THOMAS KER DRUMMOND, descended from a very old Highland family of that name, was the youngest son of James Drummond of Strageath, and was born at Edinburgh on 25th August 1805. He was educated at the High School and the University of Edinburgh, with the view of entering the legal profession; but he subsequently proceeded to Worcester College, Oxford, where he took his bachelor's degree in 1830. He was ordained a deacon the same year by the Bishop of Llandaff, and a priest in 1831 by the Bishop of Gloucester and Bristol. For the first two years of his ministry he occupied the office of curate at Henbury and Compton, and then came to Edinburgh, where he entered into the incumbency of St Paul's Episcopal

Episcopal Chapel, Carrubber's Close. Having remained here for six years, he became joint-minister of Trinity Chapel, Dean Bridge, along with the late Mr Coventry, where he laboured with much acceptability, until his connection with the Scottish Episcopal Church was severed in 1842. He then became incumbent of St Thomas's English Episcopal Chapel, and remained in the spiritual oversight of the congregation there for upwards of thirty years. During the long period of his ministry in Edinburgh, Mr Drummond endeared himself to his congregation, both by his public and private ministrations. With the ministers of other denominations he was always on the most cordial and friendly terms, and no good work, having for its object the religious or moral improvement of the people, ever failed to elicit his co-operation and sympathy. By the general public he was long known at once as the zealous advocate and upholder of English Episcopalianism in Scotland, and as an active and valued friend of evangelical movements. His writings, also, although not extensive, served to bring his name before a considerable section of the community. The most noteworthy of these were, a series of Lectures on the 17th Chapter of St John's Gospel, a Life of Montague Stanley, and Scenes and Impressions in Switzerland and the North of Italy.

Mr Drummond became a Fellow of the Royal Society in 1868. He was fond of intercourse with the lovers of literature and science, and took much pleasure in the study of natural science, especially during his residence in the country, and his visits to the Continent of Europe. He was also an excellent photographer, and executed some fine views of Scottish scenery.

Mr Drummond, who was not a man of a strong constitution, resigned his charge with advancing years, in the autumn of 1875, and only a short time ago he changed his residence from Edinburgh to Pitlochry. He was in his usual spirits on Friday, 8th June, and went to bed in apparently good health. Early on the morning of the 9th, he was seized with sudden illness, and died in a few minutes, leaving a widow and a widowed only daughter to mourn his loss.

He was buried in the churchyard overlooking the picturesque loch at Duddingstone, in the grave where he had laid his only son forty years before. The service was read by Bishop Beckles, assisted by the Rev. W. Scott Moncrieff, vicar of Bishop-Wearmouth, who was for some years Mr Drummond's colleague in St Thomas', and a large concourse of friends testified to the affection and respect in which he had been held. His funeral sermon was preached in St Thomas' and St Vincent English Episcopal Chapels, by the Rev. C. T. Astley, vicar of Gillingham, Chatham, who had formerly assisted him at St Thomas'.

WILLIAM KEDDIE became a Fellow of the Royal Society of Edinburgh in 1867, and died suddenly at Oban on 26th July 1877. He was born at Peebles on 22d March 1809, and with the exception of the first seven years, all his life-time was spent in Glasgow. At the age of thirteen he entered a printing establishment, and continued in it till he was twenty years of age. In 1832 he became sub-editor of the "Scottish Guardian," and contributed many valuable scientific articles to that newspaper. He attended also scientific classes at the University of Glasgow and the Andersonian College. He was a pupil of the Botanical class in the former, during the year 1843 when Dr Balfour was Professor. He ultimately became principal editor of the "Guardian." He was connected with the paper for twenty-seven years. Mr Keddie afterwards lecturerd on Natural History in the Free Church College. He made an excellent collection of geological and zoological specimens, which were handed over to the College. He was elected Secretary of the Glasgow Philosophical Society and editor of its Transactions. He published accounts of his visits to various Botanic Gardens in Britain, as well as to the Bass Rock and the Highlands of Scotland. His kind and genial manner and his fine flow of spirits made him a most pleasant companion in scientific excursions. His loss is much felt by the followers of science in Glasgow.

The following Communications were read:—

2. Report of the Deputation to Upsala.

By Alexander Buchan, M.A.

The Deputation appointed by the Council to represent the Society on the occasion of the 400th anniversary of the founding of the University of Upsala consisted of Mr Sprague and myself. Professor Balfour and Professor Sir Wyville Thomson, who represented the Edinburgh University, also joined the Deputation.

The Latin Address from the Society for presentation by the Deputation having been prepared, was signed in the absence of the President by the Secretary. The Address, a copy of which accompanies the Report, is in its conception and execution, a characteristic specimen of quaint and exact Latinity. It is wholly the work of Mr Gordon, the Society's Assistant Librarian.

The Deputies assembled by previous arrangement at the Grand Central Railway Station, Stockholm, on the afternoon of Tuesday, September 4, to be conveyed by royal express train to Upsala. At 4.15 P.M. the train left the station amid the cheers and congratulations of an immense assemblage of the inhabitants. About seven o'clock Upsala was reached, and the whole of the inhabitants appeared to have assembled at the station to do honour to their guests. Of this great assemblage, the white caps of the students filled the whole central space. Young Count Hamilton, in name of the students, welcomed the Deputies, and thereafter the renowned choir of this University sang one of the Swedish national airs.

In the evening a meeting of all the Deputies was held for the purpose of deciding on the order of procedure to be observed in presenting the Addresses on the Wednesday. Since the number of learned bodies represented amounted to about seventy, it was resolved that, to save time, the different bodies be grouped into nationalities, the Deputies choosing their own representative speaker, while the Addresses would be presented without remark. The British Deputies chose Professor Balfour as their representative speaker. The British Deputies were, in addition to those already named, Professor Humphry for Cambridge University, and they were joined by Dr Curling of London, Fellow of the Royal Society, the Rev. Ch. H. H. Wright, Belfast, Bampton Lecturer elect; and the Rev. Mr Metcalfe, Senior Fellow, Lincoln College, Oxford.

The festivities of the 5th were opened with salvos of cannon from the castle and peals of bells from the cathedral, and the streets were early astir with crowds already in evening costume. By nine o'clock the side aisles and tribunes of the transept of the cathedral were filled to overflowing with gaily dressed ladies. The procession formed in the upper hall of the Carolina Rediviva—the University Hall—which is a handsome structure built on a fine site overlooking the city. It then wound its way slowly down the beautiful avenue of limes called Odin's Grove to the cathedral, headed appropriately by the students with their guests from the other Scandinavian Universities, with the appropriate banners of the thirteen nations into which the Upsala students are divided; followed in order by representatives of the Universities and learned Societies of Sweden, Iceland, Copenhagen, Helsinfors, and Christiania; representatives of the Parliaments, the officials of the University of Upsala, the Charter of its foundation being carried by the Secretary of the Academy; State Councillors and Knights of the order of the Seraphim; and other civil, military, and Court functionaries, members of Parliament, and the Honorary Doctors, the rear being brought up by the municipal and other authorities of the city, and by all the other not included in the above. When all were seated, Professor Sahlin, the rector, went out to receive the King, Crown Prince, and their suite. The cantata composed for the occasion by Mr Charles D. de Wirsén was a striking feature of the day's festivities. A Latin service having been performed by Archbishop Sundberg, the Rector welcomed the Deputies in a Latin oration, and thereafter the Deputies presented the Addresses in the inverse order in which they had joined the procession. A speech from the Rector and the concluding part of the cantata brought the ceremony to an end about 2.30 P.M.

At 3 P.M. a dinner was given by the University in a large handsome hall, specially built for the festivities in the Botanic Garden. The King presided, and covers were laid for 450 guests. By far the best speech on the occasion was the King's, in reply to the toast of his health, proposed by the Rector. He urged the advantages of a scientific and classical education to even the poorest of his subjects;

sketched with a rapid but firm hand the condition of Sweden when the University was founded, and the salient points of its subsequent history; and the important part played by the University, as seen in its brilliant history during these 400 years; gave expression to a fervent prayer that it would continue to maintain and extend its renown; and concluded a most animated and eloquent speech by announcing the gift of 40,000 kronors (2000 guineas) from the Crown to the University for the encouragement of scientific research.

The town was illuminated during the evening, and what may be called the club-houses of the various "nations" were thrown open by the students, with the view of giving the guests some idea of this characteristic phase of student life at Upsala.

The ceremonial of the Thursday was the conferring of degrees, which statedly takes place in June, at the close of the spring session, but which was appropriately deferred this year so as to form part of the quater-centenary commemoration. The festivities of this day were ushered in with the same formalities, and fortunately with the same brilliant weather as favoured those of the previous day. The doors of the cathedral were thrown open at 8.30 A.M., and the seats set apart for the ladies were rapidly filled, the best places this day being reserved, not as on the Wednesday in accordance with social position, but for the friends of those who were to be made doctors in the four faculties.

The procession set out from the Carolina Rediviva at 9.15 A.M., differing from the procession of the day before in the chief place being assigned to the four Faculties and the doctors elect; and all were in due time seated in their places in the cathedral in the same admirable order that marked the whole proceedings. The King, Crown Prince, and their suite were again present, being received in the porch by the Chancellor of the University, the Archbishop, the Rector, and the four Promoters. The cantata for the promotion was the work of Mr Victor Rydberg, a popular poet, and one of the eighteen of the Swedish Academy. This cantata, with the music set to it, was, like the cantata of the previous day, of a very high order of merit, and was admirably rendered by the choir.

The ceremony of promotion occupied about three hours, the degrees so conferred being strictly limited to persons resident in Sweden, Norway, Denmark, and Finland, the universities of these countries being in peculiarly close relationship with that of Upsala. The new doctors of medicine, law, and philosophy are nominated by these respective Faculties of the University; but the doctors of theology are nominated by the King from a list submitted to him by the Theological Faculty.

Among the many quaint traditional forms with which the ceremonial was conducted may be mentioned the firing off of a piece of ordnance instantly on the crowning of each doctor; a gold ring put on the finger of each doctor in law, medicine, and philosophy; the crowning of the doctors of philosophy with wreaths of real laurel; and the recrowning of doctors of fifty years' standing, a considerable number of such jubilee doctorates being conferred. At 3 P.M. the promotion dinner was given in the large hall in the Botanic Garden, covers being laid for 1600. At dinner and during the rest of the evening the doctors of philosophy still wore their laurel wreaths.

In the meantime the gates of the Botanic Garden had been thrown open to the dense throng of the public which had been waiting outside. Shortly thereafter the King and rest of the company repaired to the open portico of the Hall, where speeches in all languages were delivered to the assembled crowds, first in front of the fine statue of Linnæus, which was crowned with laurel on the occasion, and afterwards from the broad staircase of the building, commanding a fine view of the dense crowd which filled the broad avenue leading to the Castle. Among the speakers were Chancellor Count Hamilton, Donders of Utrecht, Topelius the popular Scandinavian poet, and Professor Balfour. The speeches were varied with songs from the students, whose white caps filled the middle space of the avenue, and whose wild but well-ordered enthusiasm forms one of the pleasantest reminiscences of the festivities. As darkness set in the gardens were illuminated, and a little later there was a display of fireworks, some of the pieces being very fine, particularly one representing the new buildings of the University which are in contemplation. The festivities of the day ended with a torchlight procession of about 1000 students, who marched with their banners to the stirring music of the choir that led the procession on to the Castle, to pay their respects to the King.

On the Friday the large hall of the Carolina Rediviva was crowded by twelve o'clock with an audience of about 4000, for the concert given by the celebrated choir of the students. The membership of the choir is limited to 500, and as all in Sweden are taught music in the elementary and secondary schools, and as it is regarded an object of ambition to be admitted a member, there is no difficulty in maintaining the choir in a state of the highest efficiency. On this, as on other high occasions, old members wearing the little rosette of membership were permitted to join the choir. It is enough to say that the concert was a very fine one, and it may be added that a degree of excellence was achieved which no existing university choir could rival. The pieces selected for the concert were essentially Scandinavian, and were remarkable for the strong patriotism and inextinguishable love of freedom which breathed through them, and for a desire for union among the three Scandinavian nations. In the evening the town gave a ball, at which the King, Crown Prince, and suite, and about 7000 guests were present in the hall in the Botanic Garden—a hall, by the way, which was levelled with the ground on the following day.

By mid-afternoon of Saturday the guests had returned to Stockholm, and at 6.30 P.M. they met at the pier to be conveyed by six steamers, specially engaged for the purpose, to Drottningholm Palace. Invitations to supper were issued by His Majesty to 700 guests. The magnificent rooms of this the stateliest of the summer palaces about Stockholm were thrown open to the guests, the King freely and cordially mingling with the company, as he did during the whole of the festivities. After supper the foreign deputies were invited to meet His Majesty in one of the larger rooms, where, after a graceful speech, to which one of the deputies replied, the King touched glasses, and shook hands with many of the deputies, and bade a cordial good-bye to all. The grounds of the palace were finely illuminated.

Thus worthily terminated the commemoration solemnities of the 400th anniversary of the founding of Upsala University, the celebration and festivities being conducted in a manner and with a munificence of which Upsala and Sweden may well be proud.

The Latin Address above referred to, which was presented by the Deputation, is as follows:—

Amplissimis Curatoribus, Rectori Magnifico, Doctissimoque Senatui Universitatis Upsaliensis.

Societas Regia Edinensis nos jussit, viri illustrissimi, vobis hoc sollemni die gratulari, quo nihil exoptatius nobis evenire potest. Itaque nobis animo perpendentibus quam excultus studiorum status hodie sit, et quantopere vos in his augendis et amplificandis excellueritis, grato animo laudanda est illa fructuosissima opera quam vos et Academia vestra in finibus scientiarum dilatandis posuistis; et admirationem observantiamque nostram in viros præclaros qui temporibus præteritis exornaverunt et in successores eorum qui nunc exornant Academiam vestram libenter enuntiamus. Ab Upsala Societas nostra Regia semper lumen exspectavit et accepit; in Astronomia, Meteorologia, rebus Botanicis et Physicis, Historia Naturali, reliquisque studiis Academicis, in quæ Socii nostri continuo incumbunt, problemata difficillima solvistis, naturæ recondita extricavistis, patefecistis et illustravistis; et vestro proventu secundo Socii nostri in difficultatibus superandis valde profecerunt. In regionibus Septentrionalibus juventutem disciplinis humanis et subtilioribus instituendo Universitas Upsaliensis de republica literaria optime meruit, et laboribus suis philosophicis de rerum natura orbi terrarum notissimis fons et origo luminis fuit, imo quidem aurora borealis, vel potius sol meridianus, Sueciæ et aliarum nationum.

Ut gloria vestra per omnia sæcula permaneat ex imo pectore optamus et precationibus ominamur.

Joannes Hutton Balfour, M.D.,
Societatis Regiae Edinensis Secretarius.

Nonis Sextilibus,
ANNO CHRISTI MDCCCLXXVII.

3. On a Method of Determining the Cohesion of Liquids. By J. B. Hannay, F.C.S.

(*Abstract.*

In this paper the author concludes that the measurement of the breaking-strain of liquids is the only universally applicable method of measuring their cohesion; and as dropping is the phenomenon in which the breaking-strain can be most easily measured, he examines the work already done in this direction. Dr Guthrie's theory that

the increase in the size of drop, with the increase in the rate of dropping, is due to the attraction of the solid tearing more of the root of the drop in low than in high rates is put to a crucial test by an experiment in which mercury drops from a wide glass tube so arranged that the tube only acts as a support for a column of liquid from the end of which the drops fall. In this case there is no solid to reclaim by adhesion any of the drop, and yet there is the same increase in size as the rate increases. The author accounts for the increase as follows:—1. The rupture of the neck of a drop is not an instantaneous process, but lasts for a short time, and during that time liquid is flowing into the drop through the neck, and the faster the flow the greater is the increment of the drop during rupture. 2. When the rate is high the breaking neck has a longer life-time, as the stump follows after the full drop as in the beginning of the formation of a stream. Briefly stated, the quicker the rate the larger the drop, because more liquid flows into the drop after the rupture has commenced, and the longer does that flow continue. The author calls a drop when it begins to break a "normal" drop; and to find its weight he determines the decrease of weight with decrease of rate, and reduces the latter to zero when the weight of a normal drop is found. Apparatus is shown by which experiments were carried out, and inaccuracies eliminated. The normal drop is found to weigh 0·4130 grm., and as the width of the neck is found to be 3·395 mm., this gives a breaking strain of 0·0456 grm. per square millimeter for mercury at 16° C.

4. Note on Vector Conditions of Integrability. By Professor Tait.

(1.) The relation

$$d\sigma = uqd\rho q^{-1}$$

ensures that the tensor of $d\sigma$ shall always be u times that of $d\rho$ Hence, if ρ be the common vector of three series of surfaces which together cut space into cubes, σ possesses the same property. (See § 6 of my paper *On Orthogonal Isothermal Surfaces*, Trans. R.S.E., 1873–4. In what follows this paper will be referred to as Ω.)

We may suppose the tensor of q to be any constant, unity suppose. Then, from

$$Tq^2 = 1,$$

we have

$$S.dqKq = S.dqq^{-1} = 0.$$

Thus, it appears that

$$q^{-1}.dq \text{ and its equal } -dq^{-1}.q$$

are vectors.

(2.) From the given equation we have

$$\frac{d\sigma}{dx} = uqiq^{-1} \text{ and } \frac{d\sigma}{dy} = uqjq^{-1}.$$

From these

$$q^{-1}\frac{d^2\sigma}{dxdy}q = i\frac{du}{dy} + 2uV.i\frac{dq^{-1}}{dy}q = j\frac{du}{dx} + 2uV.j\frac{dq^{-1}}{dx}q.$$

From the three equations of this form we obtain by the operations $S.i$, $S.j$, $S.k$, nine scalar equations, of which the following are three:—

$$\frac{du}{dx} = 2uS.k\frac{dq^{-1}}{dy}q,$$

$$\frac{du}{dy} = -2uS.k\frac{dq^{-1}}{dx}q,$$

$$S.j\frac{dq^{-1}}{dy}q = -S.i\frac{dq^{-1}}{dx}q.$$

The last of these, with its two similar equations, shows that

$$S.i\frac{dq^{-1}}{dx}q = S.j\frac{dq^{-1}}{dy}q = S.k\frac{dq^{-1}}{dz}q = 0$$

which express Dupin's theorem for this particular case.

(3.) If we put for simplicity

$$dv = \frac{du}{2u}$$

the equations of last section give at once three like

$$\frac{dq^{-1}}{dx}q = V.i\nabla v,$$

so that

$$dq.q^{-1} = V.d\rho\nabla v, \quad . \quad . \quad . \quad . \quad . \quad (\Omega\ (33).)$$

and

$$\nabla q^{-1}.q = \Sigma.iVi\nabla v = -2\nabla v = -\frac{\nabla u}{u},$$

or

$$\nabla.uq^{-1} = 0. \quad . \quad . \quad . \quad . \quad . \quad . \quad (\Omega\ (13).)$$

(4.) But we have, by differentiation, from the second equations of § (3),

$$\frac{d^2q^{-1}}{dxdy}q+\frac{dq^{-1}}{dx}\cdot\frac{dq}{dy}=\frac{d}{dy}\mathrm{V}.i\nabla v\,,$$

$$\frac{d^2q^{-1}}{dydx}q+\frac{dq^{-1}}{dy}\cdot\frac{dq}{dx}=\frac{d}{dx}\mathrm{V}\,j\,\nabla v\,.$$

Subtracting, and noticing that

$$\frac{dq^{-1}}{dx}\cdot\frac{dq}{dy}=-q^{-1}\frac{dq}{dx}\cdot q^{-1}\frac{dq}{dy}\,,$$

we have

$$2\mathrm{V}.q^{-1}\frac{dq}{dx}q^{-1}\frac{dq}{dy}=\mathrm{V}.\left(j\frac{d}{dx}-i\frac{d}{dy}\right)\nabla v=\mathrm{V}.\mathrm{V}\,(k\nabla)\;\nabla v\,,$$

or

$$2\mathrm{S}(k\nabla v)\,.\,\nabla v=\mathrm{V}.\mathrm{V}\,(k\nabla)\;\nabla v\,.$$

Three like this give at once

$$(\nabla v)^2=-\nabla^2 v$$

or

$$0=2u\nabla^2u-(\nabla u)^2=4u^{\frac{3}{2}}\nabla^2\left(u^{\frac{1}{2}}\right)\quad .\quad .\quad .\quad (\Omega\ (21).)$$

(5.) But if, instead of combining the last set of three we equate to zero the scalar coefficients of i, j, k separately in each, we have three equations of each of the following forms:—

$$2\frac{dv}{dx}\frac{dv}{dy}=\frac{d^2v}{dxdy}\,,\ \frac{d^2v}{dx^2}+\frac{d^2v}{dy^2}=-2\left(\frac{dv}{dz}\right)^2.$$

Transformed to u, they become

$$2\frac{du}{dx}\frac{du}{dy}=u\,\frac{d^2u}{dxdy}\,,\quad \&c.$$

$$u\left(\frac{d^2u}{dx^2}+\frac{d^2u}{dx^2}\right)=\left(\frac{du}{dx}\right)^2+\left(\frac{du}{dy}\right)^2-\left(\frac{du}{dz}\right)^2,\quad \&c.$$

The integrals of the first three are obviously

$$\frac{1}{u^2}\frac{du}{dx}=\mathrm{X}'\,,\quad \frac{1}{u^2}\frac{du}{dy}=\mathrm{Y}'\,,\quad \frac{1}{u^2}\frac{du}{dz}=\mathrm{Z}'\,.$$

where the right hand members are functions of x, y, z respectively. Thus

$$\frac{1}{u}=-\mathrm{X}-\mathrm{Y}-\mathrm{Z}$$

and the first of the second set of three equations becomes

$$u^3(X''+Y''+2uX'^2+2uY'^2) = u^4(X'^2+Y'^2-Z'^2)\,,$$

or

$$X''+Y'' = -u(X'^2+Y'^2+Z'^2)\,.$$

Thus

$$X''=Y''=Z''=C\,,$$

and

$$\frac{1}{u} = -\frac{C}{2}\Big[(x-a)^2+(y-b)^2+(z-c)^2\Big]+C',$$

or, as we may take the origin where we please,

$$u \propto \frac{1}{CT\rho^2+D}\,.$$

This is, therefore, the *only* value of u which satisfies the conditions of the problem, and the last equation in § 4 above shows that either C or D must vanish. If C vanish, u and q are both constant.

(6.) If D vanish, we have by § 3 above

$$-dq\,.\,q^{-1} = V.d\rho\,\frac{\nabla u}{2u} = -V\frac{d\rho}{\rho} = -dU\rho\,.\,(U\rho)^{-1}\,.$$

This gives

$$q = aU\rho$$

where a is any constant versor.

Also

$$d\sigma = \frac{c^2}{T\rho^2}aU\rho d\rho(U\rho)^{-1}a^{-}$$
$$= -a\,d\left(\frac{c^2}{\rho}\right)a^{-1},$$

so that σ is the *Electric Image* of ρ rotated through any angle about any axis through the centre of the reflecting sphere. (Ω § 12.)

(7.) If the equations of any three systems of *orthogonal* surfaces be

$$F_1=C_1\,,\;\; F_2=C_2\,,\;\; F_3=C_3,$$

we may obviously write for the flux of heat through each the expressions

$$\nabla F_1 = u_1qiq^{-1}\,,\;\; \nabla F_2 = u_2qjq^{-1}\,,\;\; \nabla F_3 = u_3qkq^{-1}\,;$$

so that we have three equations of the form

$$\nabla\,(u_1qiq^{-1}) = a_1\,,$$

where a_1, a_2, a_3 are *scalars*, which separately vanish when the systems are *isothermal*.

Expanding the last equation we have

$$\frac{\nabla u_1}{u_1} qiq^{-1} + \nabla q \,.\, q^{-1} \,.\, qiq^{-1} + qiq^{-1}\nabla q \,.\, q^{-1} - 2\mathrm{S}\,(qiq^{-1}\nabla)\, q \,.\, q^{-1} = \frac{a_1}{u_1}$$

or, writing

$$qiq^{-1} = i' ,$$

$$\frac{\nabla u_1}{u_1} i' + 2\,\mathrm{S}.i'\nabla q\, q^{-1} - 2\,\mathrm{S}(i'\nabla)\, q \,.\, q^{-1} = \frac{a_1}{u_1} .$$

We obtain Dupin's Theorem in its most general form by operating by S.i', S.j', S.k' on this and the two similar equations respectively. It is thus expressed as three equations, of which one is

$$\mathrm{S}.i'\,\mathrm{S}(i'\nabla)\, q \,.\, q^{-1} = 0 .$$

Again, by multiplication by i', and by adding the other two equations multiplied by j' and k' respectively, we obtain also

$$\Sigma \frac{\nabla u}{u} + 2\,\Sigma i'\,\mathrm{S}i'\frac{\nabla u_1}{u_1} - 2\mathrm{V}.\nabla q q^{-1} + 2\nabla q \,.\, q^{-1} = \Sigma \frac{a_1 i'}{u_1}$$

or

$$\Sigma \frac{\nabla u}{u} + 2\mathrm{V}.\nabla q\, q^{-1} + 2\mathrm{V} q \,.\, q^{-1} = -\Sigma \frac{a_1 i'}{u_1}$$

whence

$$\mathrm{S}.\nabla q\, q^{-1} = 0 ,$$

and

$$\Sigma \frac{\nabla u}{u} + 4\nabla q \,.\, q^{-1} = -\Sigma \frac{a_1 i'}{u_1} .$$

When the systems are isothermal as well as orthogonal, this equation may be put in the singular form—

$$\nabla\Big[(u_1 u_2 u_3)^{\frac{1}{4}} q \Big] = 0 .$$

The results given in this section were laid before the Society in May 1876, but were mislaid, with other papers then read.

(8.) The great desideratum in the application of quaternions to problems such as those just treated, seems to lie in the discovery of the general solution of the equation

$$\nabla r = 0 ,$$

where r is a quaternion. Unfortunately this seems to depend ultimately upon Laplace's equation, treat it how we may. It is easily seen to be equivalent to the kinematical problem of finding a displacement which shall produce no compression, but shall produce a rotation whose vector axis itself corresponds to a displacement without compression.

The nature of the difficulty is also easily seen in another way; for, when we try to find the conditions of integrability of such an equation as

$$\mathrm{V} . \lambda d\mu = d\nu ,$$

we may, of course, make the assumption

$$d\mu = \phi d\rho$$

where the coefficients of ϕ are functions of ρ. This gives at once

$$\mathrm{S}\alpha d\mu = \mathrm{S}.\phi' \alpha d\rho ,$$

so that

$$\mathrm{V}.\nabla\phi'\alpha = 0$$

whatever constant vector be α.

Suppose this satisfied, we have the farther condition

$$\mathrm{V}.\lambda\phi\, d\rho = d\nu ,$$

or

$$\mathrm{S}.\phi'\mathrm{V}\,(\alpha\lambda)\, d\rho = \mathrm{S}\alpha d\nu ,$$

so that, whatever be α,

$$\mathrm{V}.\nabla\phi'\,(\mathrm{V}\alpha\lambda) = 0$$

Taken in conjunction with the former condition, this shows that ∇ may here be considered as operating on λ only.

In this very particular case, however, we find at once that λ must be constant, and that

$$d\mu = \phi d\rho = i du + j dv + k dw .$$